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PRACTICE WITH SCIENCE.

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THESE EXPERIMENTS, IT IS TRUE, ARE NOT EASY; STILL THEY ARE IN THE POWER OF EVERY THINKING HUSBANDMAN. HE WHO ACCOMPLISHES BUT ONE, OF HOWEVER LIMITED APPLICATION, AND TAKES CARE TO REPORT IT FAITHFULLY, ADVANCES THE SCIENCE, AND, CONSEQUENTLY, THE PRACTICE OF AGRICULTURE, AND ACQUIRES THEREBY A RIGHT TO THE GRATITUDE OF HIS FELLOWS, AND OF THOSE WHO COME AFTER. TO MAKE MANY SUCH IS BEYOND THE POWER OF MOST INDIVIDUALS, AND CANNOT BE EXPECTED. THE FIRST CARE OF ALL SOCIETIES FORMED FOR THE IMPROVEMENT OF OUR SCIENCE SHOULD BE TO PREPARE THE FORMS OF SUCH EXPERIMENTS, AND TO DISTRIBUTE THE EXECUTION OF THESE AMONG THEIR MEMBERS.

VON THAER, *Principles of Agriculture.*

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, STAMFORD STREET AND CHARING CROSS.

CONTENTS OF PART I., VOLUME XX.

SECOND SERIES.

APPENDIX.

DIRECTIONS TO THE BINDER.

The Binder is desired to collect together all the Appendix matter, with Roman numeral folios, and place it at the *end* of each volume of the Journal, excepting Titles and Contents, and Statistics &c., which are in all cases to be placed at the *beginning* of the Volume; the lettering at the back to include a statement of the *year* as well as the *volume;* the first volume belonging to 1839–40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In Reprints of the Journal all Appendix matter and, in one instance, an Article in the body of the Journal (which at the time had become obsolete), were omitted; the Roman numeral folios, however (for convenience of reference), were reprinted without alteration in the Appendix matter retained.

METEOROLOGY; IMPORTATIONS OF GRAIN; SALES OF BRITISH WHEAT; PRICES OF CORN AND OTHER PRODUCE; AGRICULTURAL STATISTICS; AND STATISTICS OF DAIRY PRODUCE.

[*The facts are derived chiefly from the Meteorological Reports of* MR. GLAISHER, *and the Returns of the* BOARD OF TRADE *and of the* INSPECTOR-GENERAL OF IMPORTS AND EXPORTS.]

METEOROLOGY.—1883.

First Quarter (January, February, March).—The mean reading of the barometer during the quarter was 29·796, and was 0·033 above the mean reading for the corresponding period in 42 years; the mean reading for February showed a slight excess, while that for January was below the average.

The weather in January was warm, with frequent rain; the sky was mostly overcast. The atmospheric pressure was for a few days together above its average, then for a few days below; there were heavy storms from the 24th to the 28th days. Water was standing in all low places, and the land generally was saturated, and not workable.

The weather in February was mild throughout the month, with excessive rain during the first three weeks, causing heavy floods, and perfectly saturating the land. The atmospheric pressure was low during the first half of the month and high afterwards. The last week was fine and dry.

The weather in March from the 6th day was very cold throughout the month, with but little rain, but frequent falls of snow. The atmospheric pressure was above its average during the first week and afterwards below. The wind, which was frequently from the N.E. and N.W., was dry and searching; under its influence the land dried rapidly, enabling farming work to proceed satisfactorily.

The *mean temperature* of the air for the quarter was 40°·0, and was 1°·2 above the average for the corresponding period of 112 years.

The *rainfall* measured at Greenwich during the quarter was 5·36 inches, and was 0·35 inch above the average amount in the corresponding periods of 67 years. The rainfall was equal to 1·69 inches in January, 2·89 inches in February, and 0·78 inch in March; the amount was below the average in January and March, whereas it showed an excess of 1·32 inches in February. At 40 stations of observation the recorded rainfall ranged from 4·68 inches at Cambridge to 11·64 inches at Bolton, 13·21 inches at Truro, and 14·95 inches at Totnes. Rain fell at Greenwich on 19 days in January, 15 in February, and 14 in March, in all on 48 days in the quarter.

The number of hours of bright sunshine recorded at Greenwich during the quarter was 201·4, and was 27·8 above the average number recorded in the five preceding corresponding periods.

Second Quarter (*April, May, June*).—The mean reading of the barometer during the quarter was 29·801, and was 0·019 above the mean reading for the corresponding periods in 42 years; the reading showed a considerable excess in April, whereas it was below the average both in May and June.

The weather in April:—At the beginning of the month there were a few fine warm days, but from the 9th to the 25th the weather was cold and ungenial, snow fell generally on several days. The days were frequently bright, and the nights cold; but on the whole the month was dry, no rain falling at the beginning of the month and but little afterwards, being favourable for farming operations. The month was free from thunderstorms.

The weather in May:—The first twelve days were cold, and rain or snow fell on several days at stations north of 51°. From the 12th the weather was warm and pleasant and at times hot; this fine weather continued to the end of the month. The fall of rain was generally below the average. Thunderstorms occurred on six days.

The weather in June was variable; at the beginning of the month it was warm and fine, then for a few days it was cold and warm alternately; it was very cold from the 15th to the 22nd, and unsettled afterwards to the end of the month. The fall of rain was generally below its average, on the whole the month was favourable for vegetation and farming work. Thunderstorms occurred on ten days.

The *mean temperature* of the air for the quarter was 53°·0, and was 0°·7 above the average for the corresponding period of 112 years.

The *rainfall* measured at Greenwich during the quarter was 4·75 inches, and was 1·08 inches below the average amount in the corresponding periods of 67 years. The rainfall was equal to 1·70 inches in April, 1·71 inches in May, and 1·34 inches in June; the amount was below the average in each of the three months. At 37 stations of observation the recorded rainfall ranged from 3·83 inches at Liverpool, to 8·32 inches at Leicester, 8·38 inches at Royston, 8·39 inches at Stonyhurst, and 8·61 at Cambridge. Rain fell at Greenwich on 10 days in April, 9 in May, and 13 in June, in all on 32 days in the quarter.

The number of hours of bright sunshine recorded at Greenwich during the quarter was 474·6, and was 4·5 above the average number recorded in the six preceding corresponding periods.

Third Quarter (*July, August, September*).—The mean reading of the barometer during the quarter was 29·726, and was 0·029 below the mean reading for the corresponding periods in 42 years; the greatest depression was observed in September.

The weather in July was generally fine and warm till the 10th day, followed by cold unsettled weather during the remainder of the month; between the 14th and 23rd day the weather was particularly cold. The sky was generally obscured by clouds. Upon the whole the month was cold, with rain a little above the average amount. The hay harvest was very much checked, but many crops were benefited by the rain.

The weather in August was cold at the beginning and warm generally from the 13th day, with a rainfall less than the average and a high barometer reading. It was a fine month for harvest work, and the bright sunshine after the middle of the month was favourable for ripening the green crops. The month was nearly free from thunderstorms.

The weather in September was rather cold at the beginning of the month, followed by a warm period which extended nearly to the end. The fall of rain was above the average at most stations. The harvest at all southern stations was gathered in good condition, but, at northern stations, the severe gales of wind on the 23rd and 25th days interfered with harvest operation, and in some places the crop was injured. There were very few thunderstorms in the month.

The *mean temperature* of the air in this quarter was 59·5, and

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was 0·2 below the average for the corresponding period of 112 years.

The *rainfall* measured at Greenwich was equal to 6·53 inches, and was 0·12 of an inch below the average amount in the corresponding periods of 67 years. Rain fell at Greenwich on 16 days in July, 10 in August, and 17 in September, in all on 43 of the 92 days in the quarter.

At the various stations of observation the recorded rainfall of the quarter ranged from 5·95 inches at Somerleyton to 15·31 inches at Bath.

The number of hours of bright sunshine recorded at Greenwich during the quarter was 421·6, and was nearly identical with the number in the corresponding period of last year; the average amount in the third or summer quarter of the five years 1878–82 was 408·4 hours.

Fourth Quarter (*October, November, December*). The mean reading of the barometer for the quarter was 29·814 inches, and 0·068 of an inch above the average for the corresponding period of 42 years; the mean showed an excess in October and December, but was below the average in November.

The weather in October was cold during the first week and from the 18th to the 23rd, and mild at other times, particularly so during the last week of the month. The atmospheric pressure was above its average from the 5th to the 13th, and from the 26th, and was below at other times. The sky was mostly cloudy, with but little sunshine; the fall of rain was less than its average at most stations; there were no thunderstorms at stations south of Bolton; and there were two or three at northern stations. Fog was prevalent on seven or eight days at stations in the Midland Counties. Snow fell at Halifax on five days,

The weather in November was mostly cold till the 15th, and warm from the 16th to the end of the month. The pressure of the atmosphere was generally below its average from the 4th to the 26th, particularly so on the 6th and 25th. The sky was generally clouded; there were a few bright days only. Rain fell very frequently, and generally in excess of the average. A little snow fell at different places north of latitude 51°, and fog was prevalent at some places on eight or nine days in the month. Thunderstorms occurred at several stations south of 51½°, and at stations north of 54°.

The weather in December was variable till the 18th day, the temperature being for a few days together in excess of the aver-

age, and then for a few days in defect; from the 19th day to the end of the month the weather was unusually mild. The pressure of the atmosphere was variable, being alternately above and below till the 22nd, and constantly in excess from the 23rd day. The fall of rain was a good deal below the average at nearly every station. Snow fell at a few stations during the first half of the month. There was scarcely any fog till the 15th, and from this day till the end of the month it was unusually prevalent, particularly in the S.E. of England, where fog, frequently very dense, and cloudy dull skies were all but constant. The sun was scarcely visible during the last week of the year. During the greater part of this month, whenever the sky was clear, there was a peculiar glow of light visible both before sunrise and after sunset, and at times even through the clouds.

The *mean temperature* of the air in the quarter was 44°·9, and was 1°·3 above the average for the corresponding period of 112 years.

The *rainfall* measured at Greenwich during the quarter was 5·26 inches, and was 1·93 inches below the average amount in the corresponding periods of 67 years. Rain fell at Greenwich on 14 days in October, 21 in November, and 15 in December, or on 50 of the 92 days in the quarter.

At the various stations of observation the recorded rainfall of the quarter ranged from 4·94 inches at Strathfield Turgiss, to 15·92 at Stonyhurst, and 17·77 inches at Bolton. A local observer—Mr. Arthur Marston—reports the rainfall at Binham, Ludlow, during the month of November to have been excessive; no fewer than 5·12 inches fell during the 30 days.

The number of hours of bright sunshine recorded at Greenwich during the quarter was 143·2, and exceeded by 8·9 the number in the corresponding period of last year; the average amount in the fourth quarter of the five years 1878–82 was 148·8 hours.

TABLE I.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1883.

1883.	Temperature of									Elastic Force of Vapour.		Weight of Vapour in a Cubic Foot of Air.	
	Air.			Evaporation.		Dew Point.		Air—Daily Range.					
MONTHS.	Mean.	Diff. from average of 112 years.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
January	41·2	+4·7	+2·8	39·6	+2·8	37·6	+2·9	9·1	−0·5	0·225	+0·026	2·6	+0·2
February	42·6	+3·9	+3·1	40·9	+3·2	38·8	+3·5	11·3	+0·2	0·236	+0·026	2·7	+0·4
March	36·1	−5·0	−5·7	33·2	−6·2	29·2	−7·0	14·8	+0·1	0·161	−0·056	1·9	−0·7
Means	40·0	+1·2	+0·1	37·9	−0·1	35·2	−0·2	11·7	−0·1	0·207	+0·001	2·4	0·0
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
April	46·8	+0·7	−0·3	43·3	−0·7	39·4	−1·1	20·2	+1·8	0·249	−0·004	2·8	−0·1
May	53·1	+0·6	+0·4	49·2	+0·4	45·3	+0·3	20·2	−0·3	0·303	+0·005	3·4	−0·1
June	59·0	+0·8	+0·1	54·9	+0·4	51·3	+0·7	21·9	+1·0	0·378	+0·008	4·3	+0·2
Means	53·0	+0·7	+0·1	49·1	0·0	45·3	0·0	20·8	+0·8	0·310	+0·003	3·5	0·0

NOTE.—In reading this Table it will be borne in mind that the *minus* sign (−) signifies *below* the average, and that the *plus* sign (+) signifies *above* the average.

TABLE II.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1883.

1883. MONTHS.	Temperature of Air. Mean.	Air. Diff. from average of 112 years.	Air. Diff. from average of 42 years.	Evaporation. Mean.	Evaporation. Diff. from average of 42 years.	Dew Point. Mean.	Dew Point. Diff. from average of 42 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 42 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 42 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour. Diff. from average of 42 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
July	59·9	−1·8	−2·3	56·2	−1·5	53·0	−1·0	19·3	−1·7	0·402	−0·016	4·5	−0·3
August	61·9	+1·0	+0·6	57·7	+0·2	54·1	+0·1	21·2	+1·6	0·419	0·000	4·6	−0·1
September	56·8	+0·3	−0·3	54·5	+0·5	52·4	+1·3	16·7	−1·6	0·394	+0·015	4·4	0·0
Means	59·5	−0·2	−0·7	56·1	−0·3	53·2	+0·1	19·1	−0·6	0·405	−0·000	4·5	−0·1
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
October	50·4	+0·9	+0·4	48·4	+0·5	46·2	+0·3	12·6	− 2·0	0·313	+0·002	3·6	−0·2
November	43·8	+1·5	+0·3	41·9	+0·5	39·8	+0·4	11·8	+ 0·3	0·245	−0·002	2·8	−0·1
December	40·5	+1·4	+0·6	38·7	+0·2	36·3	−0·3	8·0	− 1·4	0·214	−0·004	2·5	−0·1
Means	44·9	+1·3	+0·4	43·0	+0·4	40·8	+0·1	10·8	− 1·0	0·257	−0·001	3·0	−0·1

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

TABLE III.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1883.

1883. MONTHS.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass.				
										Number of Nights it was				
	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Amount.	Diff. from average of 67 years.		At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
January ..	87	0	29·735	−0·017	550	− 4	1·69	−0·20	339	17	13	1	21·9	49·5
February ..	86	+ 1	29·904	+0·115	551	− 2	2·89	+1·32	349	7	20	1	25·7	41·1
March ..	76	− 5	29·749	0·000	556	+ 6	0·78	−0·77	337	24	7	0	14·3	37·9
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	83	+ 1	29·796	+0·033	552	0	5·36	+0·35	342	48	40	2	14·3	49·5
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
April ..	79	− 1	29·826	+0·076	545	+ 2	1·70	−0·06	227	13	13	4	18·6	48·1
May	76	− 1	29·784	−0·007	538	− 3	1·71	−0·36	246	5	17	9	23·9	49·0
June ..	76	+ 1	29·793	−0·012	531	− 1	1·34	−0·66	255	0	9	21	31·0	56·3
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	77	0	29·801	+0·019	538	− 1	4·75	−1·08	243	13	39	34	18·6	56·3

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

TABLE IV.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1883.

1883. MONTHS.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass.				
										Number of Nights it was			Lowest Reading at Night.	Highest Reading at Night.
	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Mean.	Diff. from average of 42 years.	Amount.	Diff. from average of 67 years.		At or below 30°.	Between 30° and 40°.	Above 40°.		
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
July	78	+ 2	29·688	−0·109	528	0	1·99	−0·57	273	0	3	28	37·2	53·1
August ..	76	− 1	29·841	+0·060	529	+ 1	0·72	−1·71	252	0	7	24	32·8	56·0
September	86	+ 5	29·648	−0·154	531	− 2	3·82	+1·41	266	0	8	22	32·3	56·9
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	80	+ 2	29·726	−0·029	529	0	6·53	−0·12	264	0	18	74	32·3	56·9
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
October ..	86	0	29·800	+0·092	541	+ 1	1·59	−1·25	294	1	22	8	29·6	50·1
November	86	− 2	29·659	−0·084	546	− 1	2·84	+0·50	322	6	19	5	23·7	44·8
December	85	− 4	29·983	+0·195	555	+ 4	0·83	−1·18	369	5	26	0	24·7	38·9
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	86	− 2	29·814	+0·068	547	+ 1	5·26	−1·93	328	12	67	13	23·7	50·1

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

HAY HARVEST

RETURN SHOWING THE NUMBER OF FORECASTS SENT TO EACH
OTHERWISE OF

Districts.	To whom sent.	Addresses.
0. Scotland, N. ..	D. Melville, for the Rev. Dr. Joass	Dunrobin Gardens, Golspie
	Major Smith	Munlochy, Inverness .. ..
1. Scotland, E. ..	W. S. Macdonald ..	Craigielaw, Longniddry ..
	G. Johnstone	The Gardens, Glamis, Forfar
2. England, N.E. ..	J. Turner	The Grange, Ulceby .. ..
	J. Wilson	Chillingham Barnes, Chatton, Northumberland .. ..
3. England, E. ..	Sir J. B. Lawes, Bart.	Rothamsted, Harpenden ..
	W. Birkbeck	High House, Thorpe, Norwich
4. Midland Counties	Professor Ohm	Royal Agricultural College, Cirencester .. ..
	Charles King, for the Duke of Somerset ..	Gerrard's Cross, Bucks ..
5. England, S. ..	C. Whitehead	Barming House, Maidstone ..
	E. P. Squarey	The Moot, Downton, Wilts ..
6. Scotland, W. ..	J. S. R. Ballingal ..	Eallabus, Bridgend, Islay, N.B.
	W. Calder	Castle Hill, Dalreock, Dumbarton .. ..
	M. J. Stewart	Ardwell, Stranaer .. ..
7. England, N.W...	G. W. Wray	Leyburn, Yorkshire .. ..
	F. Harrison, for the Earl of Derby ..	Knowsley Gardens, Prescot ..
	J. F. Smith, for Lord Egerton of Tatton	Tatton Park, Knutsford ..
8. England, S.W. ..	R. Neville	Butleigh Court, Glastonbury
	J. Harle, for the Earl of Ducie	Whitfield, Falfield, R.S.O. ..
	T. Dyke	Long Ashton, Clifton, Bristol
	Colonel J. P. Turbervill	Ewenny Priory, Bridgend ..
9. Ireland, N. ..	C. C. Hamilton	Cherrymount, Moynalty ..
	Rev. A. Brown	The Manse, Hollymount ..
	J. D. Johnstone ..	Antrim Castle, Antrim .. ..
10. Ireland, S.	W. Talbot Crosbie ..	Ardfert Abbey, Ardfert ..
	D. A. M'Cready ..	Larchvale, Moneygall .. ..
	D. A. Milward	Lavistown, Kilkenny .. ..

FORECASTS, 1883.

OF THE UNDERMENTIONED PERSONS, WITH THE SUCCESS OR THE FORECASTS.

No. of Forecasts sent.	No. of Forecasts checked.	Percentages.				Remarks.
		Complete Success.	Partial Success.	Partial Failure.	Total Failure.	
30	30	33.3	40.0	20.0	6.7	Major Smith says that the forecasts were very correct on the whole, particularly those from the 24–29th July, the forecasts on those days being "wonderfully correct."
30	30	56.7	36.7	3.3	3.3	
30	30	73.3	23.4	3.3	..	
30	30	53.4	40.0	3.3	3.3	
30	30	56.7	30.0	13.3	..	Mr. J. Wilson says that owing to a very severe illness he was unable to keep a careful record, but that "there was a much greater harmony between the forecasts and the results than previously."
42	6	83.3	16.7	..	..	
27	27	48.2	33.3	11.1	7.4	
39	39	56.4	33.3	10.3	..	
33	33	45.3	39.3	12.1	3.3	
27	27	33.3	51.8	14.9	..	
24	24	62.5	25.0	4.2	8.3	
24	23	47.8	43.5	8.7	..	
30	30	46.7	43.3	10.0	..	
30	30	46.7	43.3	10.0	..	
30	30	70.0	23.3	6.7	..	
34	28	64.3	32.1	3.6	..	
34	34	64.7	32.4	2.9	..	
51	47	63.8	23.4	12.8	..	
30	29	44.8	34.5	10.4	10.3	Mr. W. Downing, in a letter to Mr. Neville, remarks "the weather reports have been in great request in this neighbourhood."
30	30	43.3	40.0	16.7	..	
30	30	36.7	40.0	20.0	3.3	
36	36	38.9	41.7	13.9	5.5	
30	23	52.2	39.1	8.7	..	
30	30	40.0	43.3	13.4	3.3	
30	30	46.7	33.3	20.0	..	
34	33	45.5	36.4	15.1	3.0	
40	40	47.5	40.0	10.0	2.5	
34	34	58.8	35.3	3.0	2.9	

The following Report on the preceding Table has been received from the Meteorological Office:—

"The issue of the forecasts commenced with those for England E., and the Midland Counties on June 14th, and as the season advanced those for other districts were added. The forecasts were issued daily, with the exception of Sundays, and in most cases were continued for a space of about five weeks. They were sent to Knutsford, however, for an additional fortnight, at the expense of Lord Egerton of Tatton.

"The result of the checking shows that the general percentage of success (88), and also the proportion of completely successful forecasts, is higher than even that of last year. The larger percentages were reached in Scotland E., England N.E., and England N.W.; the values being 95 and 93 respectively, while the smallest proportion of good forecasts (80) was in England S.W.

"An important feature is the success with which thundery weather was forecast, more particularly in the north parts of the country.

"SUMMARY OF RESULTS.

Districts.	Names of Stations.	Percentages.				Total Percentage of Success.
		Complete Success.	Partial Success.	Partial Failure.	Total Failure.	
Scotland, N. ..	Golspie and Munlochy ..	45	38	12	5	83
Scotland, E. ..	Longniddry and Glamis ..	63	32	3	2	95
England, N.E. ..	Ulceby and Chatton (Northumberland) ..	70	23	7	..	93
England, E. ..	Rothamsted and Thorpe	53	33	10	4	86
Midland Counties	Cirencester and Gerrard's Cross	40	45	13	2	85
England, S. ..	Maidstone and Downton	56	34	6	4	90
Scotland, W. ..	Islay, Dumbarton, and Stranraer	55	36	9	..	91
England, N.W. ..	Leyburn, Prescot, and Knutsford	64	29	7	..	93
England, S.W. ..	Glastonbury, Falfield, Clifton, and Bridgend (Glamorgan)	41	39	15	5	80
Ireland, N... ..	Moynalty, Hollymount, and Antrim	47	38	14	1	85
Ireland, S.	Ardfert, Moneygall, and Kilkenny	51	37	9	3	88
	Mean for all districts..	53	35	10	2	88

"The remarks made by Mr. J. Wilson and Major Smith are worthy of note, and it may be added that the proposal to cease the forecasts was followed in several instances by a request for their further continuance.

"I am, &c.,
(Signed) "FREDC. GASTER.

"*To* R. H. SCOTT, ESQ.,
"*Secretary, Meteorological Council.*"

CORN: Importations, Sales, and Prices.

Table V.—Quantities of Wheat, Wheatmeal, and Flour, Barley, Oats, Peas and Beans, Imported into the United Kingdom in the Year 1883.

1883.	Wheat.	Wheatmeal and Flour.	Barley.	Oats.	Peas.	Beans.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January ..	4,133,531	1,425,317	1,578,841	1,110,720	233,395	316,527
February	4,516,181	1,845,110	959,452	929,705	157,206	282,814
March ..	4,108,768	1,625,393	1,028,233	1,137,749	133,682	295,482
April ..	6,070,157	1,679,101	1,400,823	1,284,789	151,789	268,182
May ..	5,806,633	1,295,596	1,254,542	1,322,642	267,780	263,564
June ..	7,082,723	1,134,479	1,044,239	1,724,395	142,296	510,889
In first Six Months	31,717,993	9,004,996	7,266,130	7,510,000	1,086,148	1,937,458
July.. ..	5,265,081	1,102,094	612,935	1,396,488	100,380	352,015
August ..	6,613,009	1,085,075	284,357	1,625,191	116,882	377,269
September	6,324,190	1,053,247	1,548,227	865,245	41,120	240,370
October ..	6,225,903	1,506,198	3,058,126	1,396,783	59,694	166,090
November	4,771,672	1,198,957	2,206,385	1,172,684	275,474	219,219
December	3,162,596	1,342,962	1,617,624	1,282,076	199,920	285,700
In last Six Months	32,362,451	7,288,533	9,327,654	7,738,467	793,470	1,640,663
Year ..	64,080,444	16,293,529	16,593,784	15,248,467	1,879,618	3,578,121

Note.—The average weights *per quarter* of corn, as adopted in the office of the Inspector-General of Imports and Exports, are as follow:—For wheat, $485\frac{1}{3}$ lbs., or $4\frac{1}{3}$ cwts.; for barley, 400 lbs., or $3\frac{4}{7}$ cwts.; for oats, 308 lbs., or $2\frac{3}{4}$ cwts. Corn has been entered by *weight* instead of *measure* since September, 1864. No duty has been charged since 1st June, 1869.

Table VI.—Computed Real Value of Corn Imported into the United Kingdom in each of the Seven Years, 1877-83.

	1877.	1878.	1879.	1880.	1881.	1882.	1883.
	£.	£.	£.	£.	£.	£.	£.
Wheat ..	33,820,084	27,397,487	31,329,500	30,604,285	31,466,804	34,237,099	31,434,888
Barley ..	5,396,791	5,545,802	4,798,923	4,998,442	4 069,402	5,541,498	5,784,504
Oats ..	4,998,864	4,553,946	4,500,760	4,946,440	3,[illegible],013	4,603,983	5,043,011
Maize ..	9,851,236	12,589,422	9,802,249	11,141,642	10,392,460	6,522,070	10,314,307
Other kinds	2,321,922	1,463,433	1,634,064	1,920,787	1,617,820	1,637,282	2,114,289
Wheat Flour	6,803,327	6,790,320	8,505,308	8,721,269	9,205,807	10,631,933	12,318,144
Other kinds of Flour	17,284	32,214	25,585	36,845	24,007	21,966	31,038
Total of Corn..	63,209,508	58,372,624	60,596,389	62,369,710	60,557,313	63,195,831	67,040,181

TABLE VII.—QUANTITIES of BRITISH WHEAT SOLD in the Towns from which Returns are received under the Act of the 27th & 28th VICTORIA, cap. 87, and their AVERAGE PRICES, in each of the TWELVE MONTHS of the YEARS 1877–83.

	QUANTITIES IN QUARTERS.						
	1877.	1878.	1879.	1880.	1881.	1882.	1883.
	quarters.	quarters.	quarters.	quarters.	quarters.	quarters.	quarters.
First month ..	152,557	146,848	183,223	124,422	122,533	181,182	178,386
Second month	173,729	164,387	237,861	142,857	119,219	175,829	214,412
Third month (five weeks)	213,718	174,025	234,469	136,613	164,942	169,155	276,485
Fourth month	150,012	146,933	197,918	106,170	120,177	142,321	228,550
Fifth month ..	132,231	166,909	227,295	104,125	130,235	143,861	271,744
Sixth month (five weeks)	122,390	137,981	229,307	127,132	113,386	112,818	248,770
Seventh month	77,674	82,597	105,139	71,622	57,333	51,130	129,768
Eighth month	89,759	119,611	71,525	54,641	49,329	42,363	150,769
Ninth month (five weeks)	225,659	272,699	75,374	153,752	197,351	229,765	291,157
Tenth month	217,046	329,564	96,261	197,757	231,960	217,416	289,858
Eleventh month	175,262	216,187	156,218	172,153	194,080	192,704	278,749
Twelfth month (five weeks)	212,627	276,943	207,511	218,641	215,547	245,290	342,517

	AVERAGE PRICES PER QUARTER.													
	1877.		1878.		1879.		1880.		1881.		1882.		1883.	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
First month ..	51	7	51	11	39	3	46	2	42	7	45	8	40	3
Second month	51	8	51	5	38	0	44	0	41	10	46	0	41	0
Third month (five weeks)	51	1	49	8	39	7	56	5	42	11	44	9	42	4
Fourth month	53	4	51	3	41	0	48	2	44	8	46	2	41	11
Fifth month ..	65	10	51	11	40	10	45	4	44	6	47	4	43	2
Sixth month (five weeks)	64	6	48	0	41	8	45	1	44	9	47	4	42	10
Seventh month	62	9	44	11	44	6	43	9	46	8	48	10	42	2
Eighth month	64	11	44	7	49	4	44	0	48	7	50	0	43	7
Ninth month (five weeks)	59	1	44	1	47	7	41	9	51	4	44	0	41	10
Tenth month ..	53	7	39	7	48	10	41	4	47	0	39	8	40	5
Eleventh month	52	3	40	1	49	4	43	7	45	11	40	10	40	3
Twelfth month (five weeks)	51	6	40	8	46	7	44	2	44	7	41	5	39	7

TABLE VIII.—AVERAGE PRICES of BRITISH CORN per Quarter (Imperial measure) as received from the INSPECTORS and OFFICERS of EXCISE according to the Act of 27th & 28th VICTORIA, cap. 87, in each of the FIFTY-TWO WEEKS of the YEAR 1883.

Week ending	Wheat.		Barley.		Oats.		Week ending	Wheat.		Barley.		Oats.	
	s.	d.	s.	d.	s.	d.		s.	d.	s.	d.	s.	d.
January 6..	40	7	32	4	21	0	July 7..	42	4	28	11	23	5
January 13..	40	0	32	3	20	7	July 14..	42	2	29	2	24	1
January 20..	40	0	32	6	20	2	July 21..	42	2	27	10	23	2
January 27..	40	4	32	9	20	10	July 28..	42	1	27	6	22	8
February 3..	40	6	32	9	20	11	August 4..	43	3	30	0	23	10
February 10..	40	8	32	10	21	3	August 11..	43	6	27	9	23	11
February 17..	41	0	33	1	21	9	August 18..	43	10	28	9	23	2
February 24..	41	9	33	5	21	7	August 25..	43	8	29	4	22	11
March 3..	42	6	33	8	21	9	September 1	43	2	30	5	22	2
March 10..	42	6	33	7	22	3	September 8	41	8	32	10	20	11
March 17..	42	2	33	11	22	5	September 15	41	8	33	0	20	8
March 24..	42	4	33	3	22	1	September 22	41	9	33	9	20	6
March 31..	42	0	33	1	21	9	September 29	41	0	33	0	20	0
Average of Winter Quarter	41	3	33	0	21	4	Average of Summer Quarter	42	5	30	2	22	5
April 7..	42	0	33	2	21	9	October 6..	40	2	34	0	19	11
April 14..	42	1	33	3	21	8	October 13..	40	8	34	4	19	4
April 21..	41	8	32	10	21	9	October 20..	40	5	34	6	19	11
April 28..	42	0	32	9	21	10	October 27..	40	6	35	0	19	9
May 5..	42	10	32	4	23	2	November 3	40	3	34	7	19	7
May 12..	43	0	31	4	22	0	November 10	40	1	34	2	19	5
May 19..	43	4	30	8	22	9	November 17	40	3	33	4	19	11
May 26..	43	7	31	8	22	2	November 24	40	5	32	10	19	7
June 2..	43	5	29	3	22	5	December 1	40	2	32	6	19	5
June 9..	43	4	28	2	22	10	December 8	40	0	32	3	19	7
June 16..	42	9	25	6	22	10	December 15	39	5	31	7	19	4
June 23..	42	5	31	6	22	6	December 22	39	2	31	8	19	7
June 30..	42	3	29	8	23	5	December 29	39	0	31	7	19	1
Average of Spring Quarter	42	8	30	11	22	4	Average of Autumn Quarter	40	0	33	3	19	6

It will be observed from the results in the above Table that the year 1883 was remarkable for the absence of great fluctuations in the price of wheat, the range from the lowest to the highest being only 4*s.* 10*d.*, whereas in the previous year the range was 12*s.* 1*d.*

In 1882 the average price of wheat was 45*s.* 1*d.*, in 1883 it fell to 41*s.* 7*d.*, showing a decrease of 7·8 per cent.

During the last 56 years (1828 to 1883 inclusive) the price of wheat ranged from 38*s.* 6*d.* in 1851, 39*s.* 4*d.* in 1835, 40*s.* 2*d.* in 1864, and 40*s.* 3*d.* in 1850, to 69*s.* 9*d.* in 1847, 70*s.* 8*d.* in 1839, 72*s.* 5*d.* in 1854, and 74*s.* 8*d.* in 1855.

1883. — WEEKLY AVERAGE PRICE OF WHEAT FROM GOVERNMENT RETURNS.

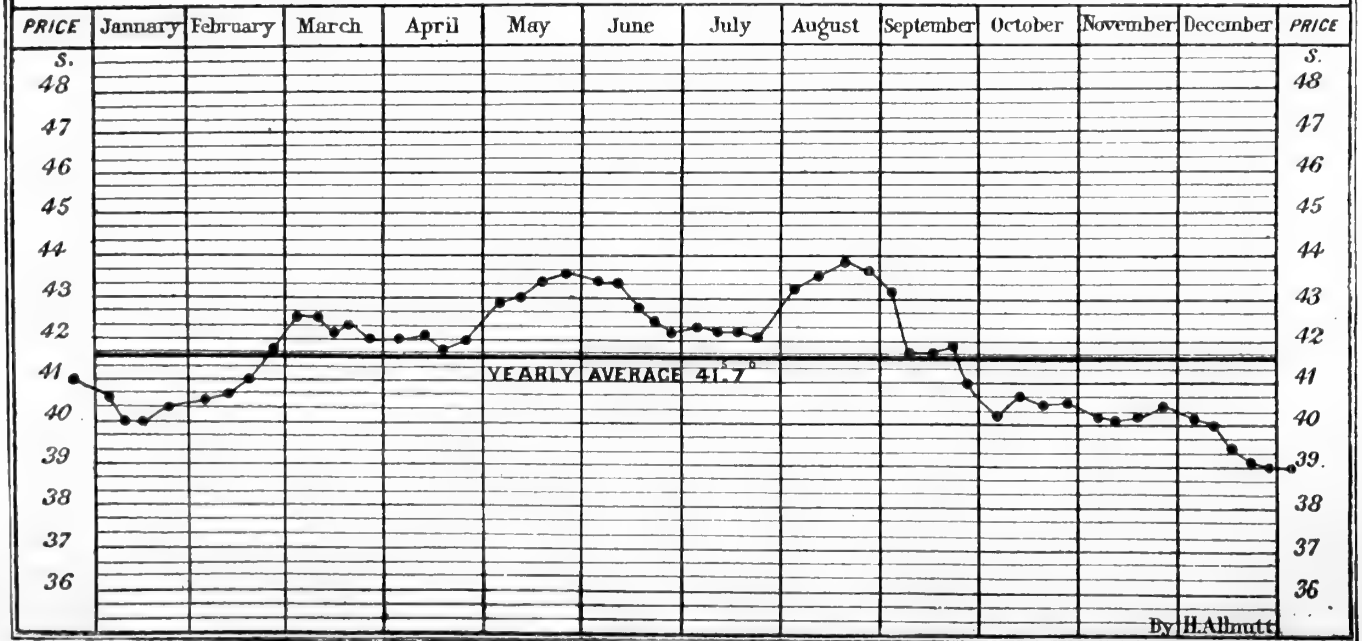

TABLE IX.—QUANTITIES of WHEAT, BARLEY, OATS, PEAS, BEANS, INDIAN CORN or MAIZE, WHEATMEAL, and FLOUR, IMPORTED in the FIVE YEARS 1879–83; also the COUNTRIES from which the WHEAT, WHEATMEAL, and FLOUR were obtained.

	1879.	1880.	1881.	1882.	1883.
Wheat from—	cwts.	cwts.	cwts.	cwts.	cwts.
Russia	7,975,144	2,880,108	4,018,895	9,571,021	13,293,358
Denmark	*	*	*	*	*
Germany	3,616,419	1,608,275	1,361,724	3,083,921	2,871,095
France	17,793	1,446	6,693	7,379	9,498
Turkey and Roumania ..	170,354	127,140	248,387	721,030	1,532,011
Egypt	2,064,397	1,590,957	1,070,488	174,862	1,174,391
United States	35,976,805	36,089,869	36,038,074	35,059,623	26,065,832
Chili	1,372,461	1,343,860	1,091,803	1,656,361	2,310,126
British India	887,256	3,247,242	7,308,842	8,477,479	11,243,497
Australia	2,245,657	4,267,743	2,978,130	2,475,127	2,691,614
British North America ..	4,676,686	3,893,544	2,860,854	2,684,828	1,798,056
Other countries	365,168	147,120	58,779	259,991	1,090,966
Total Wheat ..	59,368,140	55,197,304	57,042,669	64,171,622	64,080,444
Barley	11,541,098	11,685,527	9,811,051	15,519,850	16,593,784
Oats	13,482,607	13,862,430	10,336,795	13,646,151	15,248,467
Peas	1,916,777	2,141,438	1,972,724	2,100,197	1,879,618
Beans	2,310,101	2,574,759	2,070,199	2,074,293	3,578,121
Indian Corn, or Maize ..	36,078,586	37,153,658	33,429,722	18,255,285	31,538,952
Wheatmeal and Flour from—					
Germany	914,483	977,756	1,388,218	1,990,403	1,928,769
France	355,229	279,435	203,296	220,269	163,898
United States	6,863,172	6,908,352	7,696,415	7,777,262	11,270,918
British North America ..	460,435	521,702	260,342	339,305	469,460
Other countries	2,137,239	1,903,337	1,812,139	2,701,466	2,460,484
Total Wheatmeal and Flour	10,730,558	10,590,582	11,360,410	13,028,705	16,293,529
Indian Corn Meal	37,080	55,379	25,137	16,422	35,817

* Included under "Other Countries."

TABLE X.—AVERAGE PRICES of Consols, of Wheat, and of Meat; also the AVERAGE NUMBER of PAUPERS relieved on the *last day* of each Week; and the MEAN TEMPERATURE, in each of the Twelve Quarters ending December 31st, 1883.

Quarters ending	AVERAGE PRICES.						PAUPERISM.		Mean Temperature.
	Consols (for Money).	Minimum Rate per Cent. of Discount charged by the Bank of England.	Wheat per Quarter in England and Wales.		Meat per lb. at the Metropolitan Meat Market (by the Carcass).		Quarterly Average of the Number of Paupers relieved on the *last day* of each week.		
					Beef.	Mutton.	In-door.	Out-door.	
	£.		s.	d.					°
1881 Mar. 31	99$\frac{1}{8}$	3·19	42	3	4$\frac{6}{8}$*d.*—7$\frac{2}{8}$*d.* Mean 6*d.*	5*d.*—9*d.* Mean 7$\frac{1}{8}$*d.*	191 578	591,071	37·3
June 30	101$\frac{5}{8}$	2·65	44	6	4$\frac{2}{8}$*d.*—7*d.* Mean 5$\frac{5}{8}$*d.*	5*d.*—9$\frac{2}{8}$*d.* Mean 7$\frac{1}{8}$*d.*	173,074	558,941	52·9
Sept. 30	100$\frac{2}{8}$	3·14	48	10	4$\frac{4}{8}$*d.*—7$\frac{2}{8}$*d.* Mean 5$\frac{7}{8}$*d.*	5$\frac{2}{8}$*d.*—9*d.* Mean 7$\frac{1}{8}$*d.*	164,567	538,057	60·0
Dec. 31	99$\frac{5}{8}$	4·93	45	10	4$\frac{4}{8}$*d.*—7$\frac{4}{8}$*d.* Mean 6*d.*	5*d.*—8$\frac{7}{8}$*d.* Mean 7*d.*	178 058	539,515	44·6
1882 Mar. 31	100$\frac{3}{8}$	4·93	45	5	4$\frac{4}{8}$*d.*—7$\frac{4}{8}$*d.* Mean 6*d.*	5$\frac{4}{8}$*d.*—9$\frac{2}{8}$*d.* Mean 7$\frac{4}{8}$*d.*	187,202	560,513	42·7
June 30	101$\frac{7}{8}$	3·00	46	9	5*d.*—8*d.* Mean 6$\frac{4}{8}$*d.*	5$\frac{4}{8}$*d.*—9$\frac{4}{8}$*d.* Mean 7$\frac{4}{8}$*d.*	170,546	542,134	53·0
Sept. 30	99$\frac{7}{8}$	3·67	47	3	5*d.*—8$\frac{2}{8}$*d.* Mean 6$\frac{5}{8}$*d.*	5$\frac{3}{8}$*d.*—9$\frac{5}{8}$*d.* Mean 7$\frac{4}{8}$*d.*	165,280	529,921	58·1
Dec. 31	101$\frac{5}{8}$	5·00	40	8	4$\frac{5}{8}$*d.*—8$\frac{1}{8}$*d.* Mean 6$\frac{3}{8}$*d.*	5$\frac{3}{8}$*d.*—9$\frac{6}{8}$*d.* Mean 7$\frac{5}{8}$*d.*	180,228	534,387	44·8
1883 Mar. 31	102	3·84	41	3	5$\frac{1}{8}$*d.*—8$\frac{1}{8}$*d.* Mean 6$\frac{5}{8}$*d.*	5$\frac{7}{8}$*d.*—10$\frac{1}{8}$*d.* Mean 8*d.*	189,391	558,064	40·0
June 30	102$\frac{1}{8}$	3·57	42	8	5*d.*—8*d.* Mean 6$\frac{4}{8}$*d.*	5$\frac{6}{8}$*d.*—9$\frac{4}{8}$*d.* Mean 7$\frac{5}{8}$*d.*	172,858	537,495	53·0
Sept. 30	100$\frac{1}{8}$	3·88	42	5	5*d.*—8$\frac{3}{8}$*d.* Mean 6$\frac{6}{8}$*d.*	5$\frac{6}{8}$*d.*—10*d.* Mean 7$\frac{7}{8}$*d.*	165,263	519,260	59·5
Dec. 31	101$\frac{4}{8}$	3·00	40	0	4$\frac{6}{8}$*d.*—8*d.* Mean 6$\frac{3}{8}$*d.*	5$\frac{3}{8}$*d.*—9$\frac{4}{8}$*d.* Mean 7$\frac{4}{8}$*d.*	178,715	518,070	44·9

TABLE XI.—NUMBER of BEASTS exhibited and the PRICES realised for them at the CHRISTMAS MARKETS since 1843.

Year.	Beasts.	Prices.	Year.	Beasts.	Prices.
		s. d. s. d.			s. d. s. d.
1843	4,510	4 0—4 4	1864	7,130	3 8—5 8
1844	5,713	4 0—4 6	1865	7,530	3 4—5 4
1845	5,326	3 6—4 8	1866	7,340	3 8—5 6
1846	4,570	4 0—5 8	1867	8,110	3 4—5 0
1847	4,282	3 4—4 8	1868	5,320	3 4—5 8
1848	5,942	3 4—4 8	1869	6,728	3 6—6 2
1849	5,765	3 4—4 0	1870	6,425	3 6—6 2
1850	6,341	3 0—3 10	1871	6,320	3 10—6 2
1851	6,103	2 8—4 2	1872	7,560	4 6—6 0
1852	6,271	2 8—4 0	1873	6,170	4 4—6 6
1853	7,037	3 2—4 10	1874	6,570	4 4—6 8
1854	6,181	3 6—5 4	1875	7,660	4 6—6 6
1855	7,000	3 8—4 2	1876	7,020	4 4—6 4
1856	6,748	3 4—5 0	1877	7,510	4 6—6 0
1857	6,856	3 4—4 8	1878	6,830	4 6—6 0
1858	6,424	3 4—5 0	1879	5,620	4 0—6 4
1859	7,560	3 6—5 4	1880	7,660	4 0—6 0
1860	7,860	3 4—5 6	1881	8,150	4 0—6 2
1861	8,840	3 4—5 0	1882	7,370	4 8—6 4
1862	8,430	3 4—5 0	1883	5,940	4 0—6 4
1863	10,372	3 6—5 2			

TABLE XII.—AVERAGE PRICES of BRITISH WHEAT, BARLEY, and OATS, per IMPERIAL QUARTER, in each of the TWENTY YEARS 1864–83.

Year.	Wheat.	Barley.	Oats.	Year.	Wheat.	Barley.	Oats.
	s. d.	s. d.	s. d.		s. d.	s. d.	s. d.
1864	40 2	29 11	20 1	1874	55 9	44 11	28 10
1865	41 10	29 9	21 10	1875	45 2	38 5	28 8
1866	49 11	37 5	24 7	1876	46 2	35 2	26 3
1867	64 5	40 0	26 1	1877	56 9	39 8	25 11
1868	63 9	43 0	28 1	1878	46 5	40 2	24 4
1869	48 2	39 5	26 0	1879	43 10	34 0	21 9
1870	46 11	34 7	22 10	1880	44 4	33 1	23 1
1871	56 8	36 2	25 2	1881	45 4	35 11	21 9
1872	57 0	37 4	23 2	1882	45 1	31 2	21 10
1873	58 8	40 5	25 5	1883	41 7	31 10	21 5

TABLE XIII.—ACREAGE under each Description of CROP, FALLOW, and IRELAND,

DESCRIPTION of CROPS and LIVE STOCK.	GREAT BRITAIN. 1881.	1882.	1883.
CORN CROPS:—	Acres.	Acres.	Acres.
Wheat	2,805,809	3,003,960	2,613,162
Barley or Bere	2,442,334	2,255,269	2,291,991
Oats	2,901 275	2,833,865	2,975,381
Rye	41,567	56,553	50,768
Beans	440,201	436,882	447,934
Peas	216,790	246,851	239,439
TOTAL CORN CROPS	8,847,976	8,833,380	8,618,675
GREEN CROPS:—			
Potatoes	579,334	541,064	543,455
Turnips and Swedes	2,035,642	2,024,326	2,028,926
Mangold and Beetroot	348,872	333,645	329,937
Carrots and Parsnips	15,519	13,442	13,338
Cabbage, Kohl-rabi, and Rape	143,128	149,941	146,102
Vetches, Lucerne, and any other crop (except clover or grass)	388,073	413,242	392,821
TOTAL GREEN CROPS	3,510,568	3,475,660	3,454,579
OTHER CROPS, GRASS, &c.:—			
Flax	6,534	5,220	4,317
Hops	64,943	65,619	68,016
Bare fallow or uncropped arable land	795,809	784,425	778,203
Clover and artificial and other grasses under rotation	4,342,285	4,327,392	4,395,922
Permanent pasture, meadow, or grass not broken up in rotation (exclusive of heath or mountain land)	14,643,397	14,821,675	15,065,373
LIVE STOCK:—	No.	No.	No.
Cattle	5,911,642	5,807,491	5,962,779
Sheep	24,581,053	24,319,768	25,068,271
Pigs	2,048,090	2,510,402	2,617,757
Total number of horses used for agriculture, unbroken horses, and mares kept solely for breeding	1,424,938	1,413,578	1,410,596

and Grass, and Number of Cattle, Sheep, and Pigs, in Great Britain in 1881-83.

Ireland.			United Kingdom, including the Islands.		
1881.	1882.	1883.	1881.	1882.	1883.
Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
154,009	152,720	94,802	2,967,059	3,163,899	2,713,282
211,150	187,805	184,015	2,662,927	2,452,077	2,486,137
1,392,365	1,397,304	1,380,871	4,306,391	4,244,639	4,370,076
7,459	7,772	7,250	49,084	64,382	58,082
10,904	10,058	10,250	451,310	447,115	458,440
990	1,160	937	217,926	248,084	240,501
1,776,877	1,756,819	1,678,125	10,654,697	10,620,196	10,326,518
854,294	837,919	806,664	1,443,434	1,388,307	1,359,726
295,235	293,978	306,767	2,341,045	2,328,880	2,346,216
44,862	36,306	37,908	394,651	370,974	368,811
4,072	3,394	3,436	20,012	17,271	17,184
34,340	42,605	41,489	177,560	192,638	187,685
36,194	34,752	33,989	426,509	450,187	429,312
1,268,997	1,248,954	1,230,253	4.803,211	4,748,257	4,708,934
147,085	113,502	95,935	153,624	118,722	100,262
..	..	..	64,943	65,619	68,016
21,186	21,263	24,698	817,698	806,167	803,225
1,998,402	1,961,773	1,931,101	6,384,172	6,333,064	6,371,799
10,091,688	10,110,079	10,191,118	24,767,767	24,963,205	25,288,520
No.	No.	No.	No.	No.	No.
3,954,479	3,986,847	4,096,021	9,905,013	9,832,417	10,097,943
3,258,583	3,071,493	3,219,098	27,896,273	27,448,220	28,347,560
1,088,041	1,429,930	1,351,990	3,149,173	3,956,495	3,986,427
489,458	482,469	478,912	1,923,619	1,905,317	1,898,745

TABLE XIV.—CERTAIN ARTICLES of FOREIGN and COLONIAL PRODUCTION IMPORTED in the YEARS 1880–83; and their QUANTITIES.

	1880.	1881.	1882.	1883.
ANIMALS, Living:				
Oxen, Bulls, and Cows, number	350,950	282,691	309,360	427,445
Calves .. .. ,,	38,999	36,683	34,340	47,117
Sheep .. .. ,, / Lambs .. .. ,,	940,991	935,244	1,124,391	1,115,695
Swine and Hogs .. .. ,,	51,030	24,273	15,670	38,863
Bones (burnt or not, or as animal charcoal) .. .. tons	79,740	65,007	54,401	73,948
Cotton, Raw .. .. .. cwts.	14,547,283	14,952,724	15,794,566	15,367,874
Flax .. .. ,,	1,896,249	1,781,762	1,966,969	1,546,931
Guano .. .. tons	78,965	50,072	45,095	73,962
Hemp .. .. cwts.	1,320,731	1,475,421	1,354,407	1,440,554
Hops .. .. ,,	196,688	146,710	315,377	125,349
Hides untanned: Dry .. ,,	660,198	554,134	576,451	634,355
,, ,, Wet .. ,,	584,693	457,295	613,593	562,767
			gallons.	gallons.
Petroleum .. .. tuns	152,672	234,968	59,135,384	70,185,563
Oilseed Cakes .. .. .. tons	243,998	220,790	190,252	257,445
Potatoes .. .. cwts.	9,420,623	4,034,577	2,997,514	5,149,891
Butter .. .. ,,	2,319,802	2,046,421	2,167,428	2,332,701
Cheese .. .. ,,	1,773,503	1,834,480	1,692,495	1,797,080
Eggs .. .. .. great hundreds	6,228,437	6,306,645	6,757,234	7,826,674
Lard .. .. cwts.	929,616	855,792	665,885	852,150
Bacon .. .. ,,	4,370,860	3,858,855	2,348,060	3,080,162
Hams .. .. ,,	938,269	747,009	548,507	602,025
Salt Beef .. .. ,,	289,422	248,698	227,748	286,808
Salt Pork .. .. ,,	384,057	349,709	266,259	328,768
Clover Seeds .. .. .. ,,	271,609	279,925	354,869	317,211
Flax-seed and Linseed .. qrs.	1,712,576	1,829,838	2,437,918	2,337,867
Rape .. .. ,,	400,694	373,028	547,679	775,358
Sheep and Lambs' Wool .. lbs.	460,337,412	447,044,809	483,954,318	494,110,743

TABLE XV.—QUANTITY and VALUE of MEAT IMPORTED in the 6 YEARS, 1878–83.

	1878.	1879.	1880.	1881.	1882.	1883.
QUANTITIES.						
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Beef, Salted or Fresh ..	723,558	806,462	1,008,089	1,061,467	688,407	1,087,554
Meat, ,, ,, ..	145,493	151,505	148,788	177,931	13,016	36,459
Total	869,051	957,967	1,156,877	1,239,398	701,423	1,124,013
Meat, Preserved otherwise than by salting	438,903	566,758	655,600	575,929	559,812	609,335
Total Meat ..	1,307,954	1,524,725	1,812,477	1,815,327	1,261,235	1,733,348
VALUES.						
	£.	£.	£.	£.	£.	£.
Beef, Salted or Fresh ..	1,753,066	1,919,922	2,399,324	2,644,165	1,773,537	2,878,264
Meat, ,, ,, ..	426,864	436,317	428,285	515,812	39,981	111,955
Total	2,179,930	2,356,239	2,827,609	3,159,977	1,813,518	2,990,219
Meat, preserved otherwise than by salting	1,313,541	1,688,321	1,903,036	1,638,938	1,692,772	1,751,584
Total Meat ..	3,493,471	4,044,560	4,730,645	4,798,915	3,506,290	4,741,803

The quantity of meat imported in recent years (including pork and hams) was 2,942,319 cwts. in 1881, 2,288,087 cwts. in 1882, and 2,949,105 cwts. in 1883.

The number of bulls and cows imported was 309,360 in 1882, and 427,445 in 1883; of swine and hogs, 15,670 and 38,863 respectively; of sheep and lambs, 1,124,391 and 1,115,695; and of calves, 34,340 and 47,117 respectively.

In 1881 the average price of beef per lb. was $5\frac{7}{8}$*d.*; of mutton per lb., $7\frac{1}{8}$*d.*; in 1883 the average price of beef was $6\frac{5}{8}$*d.*, and that of mutton $7\frac{6}{8}$*d.*, which prices showed percentages of increase of 12·8 and 8·8 respectively, compared with the prices in 1881.

STATISTICS OF DAIRY PRODUCE.

The following remarks relating to butter and cheese are extracted from 'The Grocer':—

Cork Butter Market.—The crash of the "butter corner" in America, and the fear of heavy arrivals from that country, largely contributed to the depression in the values of Cork butter in the opening months of 1883, and also considerably influenced the course of prices during the following season.

The quotations for the new brands opened very high, at 141*s.* for firsts and 120*s.* for seconds; but within a month they were quoted at 101*s.* and 91*s.*

Thirds and fourths fetched but very poor prices all the year, and will, very probably, occupy the same position henceforward, as the days of inferior butter commanding anything like a remunerative price have passed away for ever. Firsts touched their lowest point on July 6, when they were quoted at 95*s.* Seconds did not go below 88*s.* during the year, at which figure they were quoted on May 31, June 18, and July 7. The prices of mild-cured butters kept within a few shillings of corresponding brands in ordinary all through the year.

The monopoly which the Wholesale Society has got of the trade for the finer brands kept prices almost at a standstill for the summer months, and bids fair to destroy all healthy competition in Cork Market while the present system so completely plays into their hands, and prevents the possibility of the Cork merchants entering the lists of competition with this formidable antagonist. It was only in the months of September and October, when the Wholesale Society began to take in their winter stocks, that the prices advanced.

From then till now there has been but little fluctuation, except in the prices of thirds, fourths, and fifths, which, during the months of November and December, have steadily declined until they reached quotations for thirds, about 20*s.* under the price asked for best butterine, and for fourths something about the ordinary value of cellar-grease, notwithstanding that the butters now being sold under those brands are the genuine produce of Irish dairies! So far as it can be ascertained, there is a smaller quantity of butter in the hands of the Cork merchants this January than has been the case for very many years, and in a few weeks hence it will not be easy to obtain any supplies of grass-made butter from the usual sources in Cork. There was a considerable falling-off in the supplies to Cork Market last year—something over 40,000 casks.

The commencement of the year 1883 found the Cork Butter Market an object of very great solicitude to a large committee of the landed proprietors in Ireland (including a great many members of the Houses of Lords and Commons), dairy farmers, country butter merchants, and others, whose objects, according to the resolutions in their circular, were to secure—

1. The opening of the Cork Butter Market, so that all persons who chose might be at liberty to make purchases on a market through which passes two-fifths of the entire butter produce of Munster, unhampered by unreasonable restrictions.

2. The abolition of the compulsory use of market brands, so as to allow each exporter of butter to use the brand that he thinks most likely to advance the butter trade of the country, and for the value of which he would be directly responsible to his customers.

This committee was formed on the publication of the report of the Duke of Richmond's Commission in reference to the Cork Market, which, if not a very long, was a very pregnant one.

The report was:—

"1. The Cork Market has ceased to be an institution that can be favourably spoken of.

"2. The present arrangements evidently tend to reduce the value of the highest classes of butter, and to unduly raise that of a lower class.

"3. The Cork Butter Market is in no real sense an open market. . . . The management is in the hands of a close corporation, who discourage individual enterprise."

The Butter Trade in Leith.—The trade during the whole of the past year cannot be said to have been altogether satisfactory. Importers rarely made a remunerative margin on their shipments;

and dealers, owing to the keen competition, did not get sufficient profit on their purchases to cover all the risk and the working expenses. The arrivals from the continent of Europe were as large as in the previous year, but prices, on the average, were about 6*s.* to 10*s.* per cwt. lower during the season. There have been again great complaints of the non-keeping quality of Estate butter, owing, it is believed, to the new centrifugal process introduced into Denmark and Sweden, whereby a larger outcome of butter is given at the expense of quality. Much of the Kiel and Mecklenburg butters, too, had too much milk in them, and became very soon mouldy and green. Danish and Swedish factory butters were, as a rule, improved in quality, and kept much better than the Estate productions. The shipments from America were larger than last year, and, on the whole, as long as the trade lasted, left a fair profit; but, as prices have now advanced so much in New York, importations have almost ceased from there for the season. In Irish butter only a moderate business has been done. All secondary kinds of continental butters have been greatly interfered with by butterine, which has been largely imported here, chiefly from Holland. The article is wholesome, and for some purposes very useful; but it is to be regretted that it is not sold for what it really is. The direct arrivals for the past year into this port are as follows:—From Denmark, Sweden, and Hamburg, 92,196 casks; from Holland (principally butterine), 191,286 firkins.

Foreign Butter.—The trade in these descriptions has again been an extensive one during the year 1883, and fully up to the average of former seasons, although prices, the same as those for Irish, have been comparatively moderate. The top point for Dutch butter was 134*s.* to 150*s.* in January and February last, from which rates there was a rapid and continuous decline until the beginning of June, when the quotations were only 95*s.* to 100*s.*; but a stronger demand arose in the two following months, and in August 116*s.* to 120*s.* were obtained. Later on, an additional rise took place, and the closing rates were 124*s.* to 136*s.* per cwt. First and second qualities of Normandy butter at the commencement of the year were worth 100*s.* to 150*s.*; but general depression setting in by the month of June, not above 90*s.* to 114*s.* were the prices then. In the subsequent months, however, as arrivals diminished and holders were less anxious sellers, they rose to 100*s.* to 120*s.*; again, in the autumn, to 110*s.* to 132*s.*; and finally, in November and December, to 116*s.* even up to 144*s.* for the very finest brands. American butter has been more freely dealt in on proportionate terms, and an increasing trade has been done in

butterine and other substitutes for the genuine article, at very reasonable prices.

Cheese.—The official returns of the year's imports of cheese into the United Kindom are not yet published; those for the eleven months gave the total as 1,687,269 cwts., against 1,564,077 cwts. in 1882, and 1,710,698 in 1881, thus evidencing a tolerably abundant supply of foreign sorts, amongst which American have occupied the most prominent position. Prices of these in London earlier in the year ranged from 46*s.* to 74*s.* for useful and choicest qualities, but the value of the best makes subsequently declined to 67*s.*, and again to 56*s.* to 60*s.* during July, August, and September, when large quantities of new cheese were pressing on the market. Latterly the finer grades have been sold at more money, up to 66*s.*, while the inferior kinds have been disposed of cheaply, down to 40*s.*, and some rather rubbishing and stale parcels even as low as 25*s.* to 35*s.* per cwt. Gouda and Edam cheeses have not fluctuated much in price, the tendency having mostly been in one direction, viz., in favour of the buyer, from 54*s.* to 70*s.*, early in the spring, backwards to 50*s.* to 62*s.* in the latter half of 1883. English cheese, whether plentiful or otherwise, has continued to command relatively good prices, the superior qualities as much as 80*s.* to 86*s.*, and even the commoner descriptions have seldom been procurable under 60*s.* to 65*s.* per cwt., with a uniformly steady demand.

The following Quotations, &c., are extracted from 'The Grocer.'

TABLE XVI.—AVERAGE and CURRENT PRICES of BUTTER and CHEESE on 1st SATURDAY in JANUARY of each YEAR, from the latest actual MARKET SALES.

	Average Annual Price in the 5 years, **1875–79.**	Current Price, 1st January, **1880.**	Current Price, 1st January, **1881.**	Current Price, 1st January, **1882.**	Current Price, 6th January, **1883.**	Current Price, 5th January, **1884.**
	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.
Butter:						
Carlow, finest, F.O.B	131 to 144	126 to 140	120 to 140	112 to 138	120 to 140	.. ..
,, Landed ..	138 ,, 148	.. ..	.. ..	.. ..	.. ..	.. ..
Cork, 1sts..	143 ,, 148	145 ,, ..	141 ,, ..	136 ,, 140	.. ..	134 to 143
,, 2nds	133 ,, 137	143 ,, ..	132 ,, 135	129 ,, 131	120 ,, 136	130 ,, 134
,, 3rds, new ..	108 ,, 109	115 ,, ..	105 ,, ..	131 ,, 113	120 ,, ..	104 ,, 105
,, 4ths	90 ,, 91	96 ,, ..	78 ,, ..	82 ,, ..	91 ,, 92	75 ,, 80
Limerick	124 ,, 129	.. ..	.. ..	.. ..	.. ..	.. ..
Foreign:						
Friesland	132 ,, 137	128 ,, 134	120 ,, 130	125 ,, 144	125 ,, 136	124 ,, 136
Jersey, &c.	94 ,, 134	125 ,, 136	110 ,, 125	110 ,, 140	110 ,, 134	95 ,, 125
Kiel	135 ,, 164	.. ..	.. ..	.. ..	.. ..	.. ..
Normandy	92 ,, 151	120 ,, 146	108 ,, 140	.. ..	.. ..	.. ..
American	81 ,, 121	90 ,, 135	95 ,, 125	60 ,, 122	.. ..	75 ,, 126
Bosch	.. ..	65 ,, 95	65 ,, 84	50 ,, 85	60 ,, 90	45 ,, 80
Cheese:						
English Cheddar, fine, new	72 ,, 90	72 ,, 86	76 ,, 90	76 ,, 82	68 ,, 82	72 ,, 86
,, good, new	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
Red Somerset Loaf..	77 ,, 87	74 ,, ..	76 ,, 82	74 ,, 78	74 ,, 76	72 ,, 80
White or yellow Cheddar Loaf ..	78 ,, 87	.. ..	.. ..	.. ..	.. ..	.. ..
Scotch Cheddar ..	164 ,, 189	.. ..	.. ..	.. ..	.. ..	.. ..
Cheshire, new.. ..	78 ,, 86	64 ,, 86	74 .. 88	72 ,, 82	68 ,, 80	74 ,, 86
,, good ditto	53 ,, 71	.. ..	.. ..	.. ..	.. ..	.. ..
Wiltshire, new ..	70 ,, 79	62 ,, 76	70 ,, 80	64 ,, 74	62 ,, 72	64 ,, 72
,, good ditto	60 ,, 68	.. ..	.. ..	.. ..	.. ..	.. ..
North Wilts Loaf, new	72 ,, 81	.. ..	72 ,, 82	76 ,, 81	74 ,, 76	72 ,, 78
Derby ,, ,,	74 ,, 64	70 ,, 74	76 ,, 84	60 ,, 74	72 ,, 76	66 ,, 76
Foreign:						
American, fine ..	63 ,, 67	64 ,, 68	68 ,, 72	60 ,, 68	62 ,, 70	60 ,, 65
,, good ..	41 ,, 59	56 ,, 60	56 ,, 66	42 ,, 60	46 ,, 58	40 ,, 58
Gouda	52 ,, 61	56 ,, 62	60 ,, 66	56 ,, 62	54 ,, 62	54 ,, 64
Edam, new	56 ,, 65	56 ,, 64	62 ,, 68	57 ,, 64	56 ,, 64	56 ,, 66
Gruyère, new	76 ,, 85	71 ,, 78	62 ,, 82	72 ,, 75	72 ,, 75	76 ,, 78

TABLE XVII.—QUANTITY and VALUE of BUTTER IMPORTED from DENMARK, 1866–82.

Years.	Quantities.	Computed Real Value.	Years.	Quantities.	Computed Real Value.
	Cwts.	£.		Cwts.	£.
1866	67,305	319,528	1875	206,171	1,275,870
1867	80,589	422,479	1876	205,195	1,311,234
1868	79,437	471,262	1877	210,322	1,347,791
1869	103,613	574,981	1878	242,427	1,517,467
1870	127,013	767,190	1879	281,740	1,673,452
1871	140,851	803,226	1880	300,157	1,777,176
1872	173,574	1,009,322	1881	279,625	1,691,894
1873	201,558	1,203,459	1882	304,732	1,850,586
1874	226,053	1,363,433			

TABLE XVIII.—QUANTITY and VALUE of BUTTER Imported from the UNITED STATES, BELGIUM, FRANCE and HOLLAND; and of CHEESE Imported from the UNITED STATES and HOLLAND, 1868–82.

Years.	UNITED STATES. Butter. Quantities.	Butter. Computed Real Value.	Cheese. Quantities.	Cheese. Computed Real Value.
	Cwts.	£.	Cwts.	£.
1868 ..	7,117	37,279	489,117	1,439,380
1869 ..	17,203	84,603	487,870	1,612,325
1870 ..	16,915	80,928	555,385	1,861,263
1871 ..	83,775	394,359	731,326	2,014,805
1872 ..	45,765	199,679	598,198	1,701,435
1873 ..	43,406	199,639	790,238	2,353,181
1874 ..	36,307	188,769	849,933	2,589,776
1875 ..	40,331	205,900	958,978	2,786,027
1876 ..	118,131	593,122	936,203	2,564,977
1877 ..	188,491	920,561	1,082,844	3,129,829
1878 ..	219,794	998,766	1,345,745	3,306,612
1879 ..	301,054	1,243,075	1,214,959	2,467,651
1880 ..	277,790	1,343,967	1,171,498	3,411,625
1881 ..	174,246	845,125	1,244,419	3,555,702
1882 ..	51,246	250,764	969,502	2,711,259

Years.	BELGIUM.—Butter.		FRANCE.—Butter.	
	Cwts.	£.	Cwts.	£.
1868 ..	70,456	405,987	393,578	2,156,824
1869 ..	85,789	481,609	407,432	2,231,450
1870 ..	84,408	516,643	289,692	1,672,899
1871 ..	94,539	523,460	304,683	1,636,006
1872 ..	74,191	409,555	355,089	1,916,795
1873 ..	76,610	439,501	446,550	2,409,861
1874 ..	76,723	465,517	713,251	3,944,233
1875 ..	79,950	499,028	567,560	3,387,219
1876 ..	65,309	419,209	622,488	3,732,405
1877 ..	58,200	378,435	606,762	3,654,488
1878 ..	80,073	499,889	555,272	3,179,326
1879 ..	63,032	391,166	438,725	2,264,591
1880 ..	53,259	302,993	531,649	2,826,586
1881 ..	50,118	285,606	496,724	2,720,831
1882 ..	54,854	301,675	575,560	3,241,622

Years.	HOLLAND. Butter.		Cheese.	
	Cwts.	£.	Cwts.	£.
1868 ..	343,322	1,992,414	329,565	959,547
1869 ..	415,176	2,253,420	426,913	1,262,101
1870 ..	406,795	2,388,459	422,553	1,204,830
1871 ..	390,616	1,986,708	348,148	954,236
1872 ..	269,091	1,358,579	329,535	942,537
1873 ..	279,004	1,453,875	336,654	1,013,233
1874 ..	351,605	1,877,755	398,888	1,164,921
1875 ..	357,106	1,917,910	370,123	1,078,594
1876 ..	402,984	2,252,909	330,435	949,413
1877 ..	372,134	2,084,686	341,980	984,855
1878 ..	460,601	2,494,903	355,159	1,018,669
1879 ..	655,377	3,331,149	275,039	743,107
1880 ..	810,509	4,076,399	288,666	810,590
1881 ..	745,536	3,745,885	264,626	747,052
1882 ..	921,182	4,310,830	310,735	866,061

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OF THE

ROYAL AGRICULTURAL SOCIETY

OF ENGLAND.

I.—*The Agricultural Holdings (England) Act*, 1883. By FREDERICK CLIFFORD, of the Middle Temple, Barrister-at-Law.

IN the 'Journal' for March, 1876,* I sketched and endeavoured to explain the provisions of the Agricultural Holdings (England) Act, 1875.† That statute was amended in the Session of 1876 by a short Act,‡ of no general interest, requiring previous assent by patrons of benefices, or by the Governors of Queen Anne's Bounty, in cases where landlords, being incumbents of ecclesiastical benefices, proposed to exercise the powers of the principal Act. Now, a new order of things exists. Since January 1, 1884, both these statutes stand repealed by the Agricultural Holdings (England) Act, 1883 §; and when the Revised Edition of the statute-book comes down to its date, their accustomed places in it will know them no more.

Critics of the Act of 1875 may reasonably differ as to its frame-work, and may differ still more upon the principle which governed it. Few will deny that, at least, it gave us solid standing-ground in its recognition of free contract as the proper basis for legislation. For good or for ill, Parliament has now embodied in statute its conviction that tenants cannot be left to take care of themselves on a hiring of land, but must be relieved from the results of their own neglect to obtain fair terms, or even, it may be, from written conditions into which

* Vol. xii. s.s. Part I.

† 38 & 39 Vict. c. 92.

‡ 39 & 40 Vict. c. 74.

§ 46 & 47 Vict. c. 61, ss. 53, 62.

they have deliberately entered. We must now assume that such legislation is necessary and expedient on grounds of public policy; but, in contrast with that of 1875, it seems to offer no assurance that legislative interference, once exercised in this direction, may not be pushed much farther.* However this may be, Parliament has pronounced its decree; and, happily, it is the custom of Englishmen, whatever their previous opinions on points of policy, to yield to the law so pronounced a loyal, ungrudging obedience, trying to make the best of it in practice, and leaving its value to be determined by time and experience.

Has the test of time, then, shown the legislation of 1875 to have been without value? I believe, on the contrary, that it proved of great value, and that its authors have much reason to be satisfied with their work. Its direct effect, though not large, has been under-rated. It was adopted in whole or in part on many estates all over the kingdom. If on many more estates landlords contracted themselves out of its provisions, this was rarely done from a wish to deprive tenants of any benefits which they might fairly take under it, but for other and more legitimate causes; because, for example, the usage on many estates was for landlords to find the money for all or most permanent improvements, giving out-going tenants fair compensation for their improvements according to local custom;† or because there was a not unreasonable fear of litigation and a desire to watch the working of the law before adopting it. Tenants, indeed, were sometimes as eager as landlords to contract themselves out of the Act, being in such cases better satisfied with the *status quo*, with the customs or conditions already regulating their holdings.‡ Nor did exclusion of the Act necessarily mean dislike of all its provisions, for agreements

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* "Probably at no period in our history have the powers of resistance to agrarian measures of any kind been less powerful, or schemes of such reform been more numerous and wide-reaching. The present Session, beyond all its predecessors, has been fruitful in germs which may well raise expectations as regards their possible development."—The Right Hon. G. Shaw-Lefevre, on the Agricultural Holdings Act, 1883, 'Nineteenth Century,' October, 1883.

† See Report of Royal Commission on Agriculture; evidence as to Crown and Duchy of Lancaster lands, pp. 7, 39.

‡ Thus the agents of the Ecclesiastical Commissioners report in March 1876, that they "find a general indisposition on the part of tenants to adopt this Act, and that "in many cases the tenants had already given notice to exclude it, requiring more time to consider the provisions of the Act."—House of Commons Paper 163 (Session 1876). Again, in February 1876, the Oxfordshire tenants of Lord Jersey were "unanimously of opinion that, owing to the complicated nature" of the Act, they would rather remain under their existing agreements, provided they had the privilege of a year's instead of six months' notice.—Royal Commission on Agriculture, Appendix to Part I., p. 296.

made with a view to exclusion often incorporated some of these provisions, as to compensation, as to notice, fixtures, or procedure.* Thus, as its authors foresaw, the indirect effect of the Act of 1875 was very considerable, and was invariably exerted in the tenant's favour, securing to him some, at any rate, of the liberal concessions provided for in the Act, by the very agreement which, in terms, excluded the Act. Such an influence, even if it made slow way, was a thoroughly sound and healthy influence, consistent with the best English traditions. By force of example, by common usage, by experience of its beneficial working where custom and agreement provided no better code, that contained in the Act of 1875 had already done something to improve the relations of landlord and tenant, and would gradually have done much more.† Meanwhile it kept in constant view a liberal and an authoritative series of provisions, conceived in the tenant's interest, and to which he might always appeal with reason in entering upon or renewing any holding. It reversed the presumption of law, too, in his interest, by giving to him instead of to his landlord, under certain conditions, the proprietary right in improvements. Moreover, it paved the way for more substantial changes. English legislation, as a rule, has hitherto moved by steps, each step justified more or less by experience of the last. Under the old conditions of tenure, British agriculture, notwithstanding many shortcomings, had, taken as a whole, shown more skill and enterprise, and had developed the soil to better purpose than the agriculture of any other country. Those persons whose position and livelihood depended on the results showed some natural hesitation in departing from the ancient ways. The Act of 1875 proved that some, at least, of the old conditions might be safely relaxed in view of social and economic changes which had made them onerous and unreasonable. Thus, great as was the repugnance with which many persons viewed, and still view, the new principle that the State should force certain arrangements upon owners and cultivators of the soil, this feeling would have been far stronger had it not been for our experience of the beneficial

* See Report of Royal Commission, and evidence of Mr. Sturge, Mr. E. C. Squarey, and others.

† As to the indirect effects of the Act of 1875 mentioned in the text, see also the discussions, December 3 and 17, 1883, and January 14, 1884, on an able paper on the new Act read by Mr. Willis Bund, barrister-at-law, before the Institution of Surveyors, a body of men upon whose intelligent interpretation and working of the compensation clauses in the new as in the old statute its success must largely depend, and whose practical experience as law agents and valuers in all parts of England, gives the highest value to their opinions on this subject.—'Transactions,' vol. xvi.; Session 1883-4. The Surveyors' Institution is now incorporated by Royal Charter.

working of the previous enactment.* This was no small gain; nor is it all, for, as will hereafter appear, the later statute continues, in whole or in part, several substantial provisions in the Act of 1875, together with the procedure clauses and much of its machinery, a tribute to its authors and draftsman which alone show that their labour has not been wasted.

Arrangement and Application of the new Act.

Its short title is "The Agricultural Holdings (England) Act, 1883" (§ 63). According to the modern practice of so drafting Bills as to leave the smallest possible opening for discussion or objection, the new Act, like the old one, opens without any preamble. A recital of the general object which Parliament desired to promote was never omitted from the older statutes, and was often full and even diffuse. It served as a guide to judges in determining a doubtful point of construction, but no such light is afforded them here. For convenient reference, the Act is divided into three Parts: the first relating to compensation for improvements and the procedure for recovering it; the second confined to changes made in the law of distress; the third comprising various general provisions. It will be convenient in this notice not to follow the sections in their exact numerical order, but to consider together those which are related.

Commencement of Act.—For certain purposes, as we shall presently find, the Act is retrospective. Subject to this limitation, it came into force, as already stated, on January 1, 1884 (§ 63), on and after which date the Act of 1875 and the amending Act of 1876 before mentioned were repealed (§ 62). This appeal does not affect (*a*) any proceedings pending under the Act of 1875; (*b*) any right to compensation for improvements to which that Act applies if they were executed before January 1, 1884; or (*c*) if they were executed after that date under a tenancy, parol or otherwise, current on January 1, 1884; (*d*) any right in respect of fixtures affixed to a holding before January 1, 1884 (§ 62). In other words, rights which have accrued to any tenant under the Act of 1875 are not touched by the new law. They must be enforced, of course, in the manner specified by that Act.

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* The Duke of Richmond and Gordon, who upon this question speaks with a double authority, is of opinion that the Act of 1875 went as far as public opinion at that time was prepared to sanction, and that the Act of 1883 could not have passed but for the example set in 1875.—Speech at Chichester, December 5th, 1883.

Limits of Act.—The Act does not extend to Scotland or Ireland (§ 64). Ireland, with its special legislation, stands in no need of the comparatively mild remedies here enacted. For Scotland an Act was passed last Session * on the model of the English Act, and not practically differing from it, except on some points of small importance and in the adoption of the machinery of the Scotch law for purposes of procedure.

Holdings to which the Act applies.—The Act of 1875 did not apply to holdings under two acres, or to market-gardens. The new law extends to holdings of any size, provided they are agricultural or pastoral, or of a mixed character. It therefore includes allotments and plots of land let to farm-labourers. It also includes any holding cultivated in whole or in part as a market-garden. It does not include "any holding let to the tenant during his continuance in any office, appointment, or employment held under the landlord" (§ 54). The object of this exception clearly is to prevent a bailiff or labourer who leaves his employment from retaining land which would not be let to him but for his employment, and would usually go to his successor. In these cases, when the tenancy is from year to year, there should be a clear expression in writing of an intention that the land, however small in extent, should be held upon condition of its surrender at the termination of the tenant's engagement; otherwise there may be frequent disputes as to the application of the Act in respect of compensation, notice, or otherwise.

Definition.—Landlord is defined (§ 61) to mean "any person for the time being entitled to receive the rents and profits of any holding," and would therefore mean any farmer or employer sub-letting a part of his land to his bailiff or labourers.

Compensation for Improvements.

Lord Ashburton, when examined before a Committee of the House of Commons in 1836, was asked whether he could suggest any legislative measure by which the interests of agriculturists could be promoted without prejudice to the general interests of the community. His reply, often since repeated in substance, was: "I really do not know anything you can do for agriculturists but to tell them honestly that no Parliamentary relief is possible. I am not aware of anything that can be done for agriculture by Parliament."† This principle of self-help is

* 46 & 47 Vict. c. 62.

† Committee on the State of Agriculture, Third Report, 1836; Minutes of Evidence, p. 498.

abandoned in recent legislation, and the first words of the new statute are a response from Parliament to the farmer's call for aid. The general rights of tenants for compensation, under the statute or by adequate agreement, are recognised as absolute, if they comply with the provisions of the statute. To make section 1 intelligible, however, it will be best to begin by transferring to this place from Schedule I. the improvements admitted throughout the Act as—

Subjects for Compensation.—It will be remembered that the Act of 1875 divided improvements into three classes. The same division is adopted in the new Act, though with a different arrangement. First come fourteen kinds of improvements, to which the assent of the landlord is required. They are the following:—

1. Erection or enlargement of buildings.
2. Formation of silos.
3. Laying down of permanent pasture.
4. Making and planting of osier-beds.
5. Making of water-meadows, or works of irrigation.
6. Making of gardens.
7. Making or improving of roads or bridges.
8. Making or improving of water-courses, ponds, wells or reservoirs, or of works for the application of water-power or for supply of water for agricultural or domestic purposes.
9. Making of fences.
10. Planting of hops.
11. Planting of orchards or fruit-bushes.
12. Reclaiming of waste land.
13. Warping of land.
14. Embankment and sluices against floods.

Only two of these improvements are new, namely, No. 2, formation of silos, which in 1875 were almost unknown in this country; and No. 14, embankment and sluices against floods. The rest are taken literally from the first-class improvements of 1875, with the addition of "fruit-bushes" to orchard-planting in No. 11, and of "works for the application of water-power" in No. 8.

We next come, in Part II. of Schedule I., to No. 15, Drainage, which stands as an improvement by itself; and in respect of which the landlord's consent is not required, though he must have notice of the tenant's intention to execute it. Drainage was included in the first-class improvements of 1875, for which the landlord's consent was required. It will be seen hereafter that the notice to landlords now required before tenants begin to drain may carry with it important consequences.

In Part III. of Schedule I., corresponding with Classes 2 and 3

in the Act of 1875, come eight improvements, in respect of which tenants do not require a landlord's consent, and need give him no notice. They are—

16. Boning of land with undissolved bones.
17. Chalking of land.
18. Clay-burning.
19. Claying of land.
20. Liming of land.
21. Marling of land.
22. Application to land of purchased artificial or other purchased manure.
23. Consumption on the holding, by cattle, sheep, or pigs, of cake or other feeding-stuff not produced on the holding.

None of these improvements are new; they are taken word for word from the Act of 1875, but the first six were there included in Class 2, for which notice to the landlord was necessary. The last two form Class 3.

Here, then, are twenty-three kinds of improvements for which a tenant may claim compensation under the new law. For shortness, the three classes will hereafter be referred to as (1) permanent improvements; (2) drainage; and (3) temporary improvements. The next question is, Who is a tenant entitled to claim compensation?

Definition of Tenant.—In the Act under review, "contract of tenancy" is defined (§ 61) as "a letting or agreement for the letting of land for a term of years, or for lives, or for lives and years, or from year to year." This definition is taken from the old Act, with an unimportant addition, not there to be found, of the words "or agreement for the letting," which seem to be surplusage, inasmuch as a letting of land would be held to be a letting under written agreement or by word of mouth. But there is also an important omission, for tenancy under the Act of 1875 also meant a letting "at will." It follows that, in the very rare cases in which tenants are tenants at will, they are not entitled to the benefits of the new Act, and that tenants for shorter periods than from year to year are equally outside its provisions.

The word "tenant," then, means a holder of land on the tenure defined in "contract of tenancy." It also includes all his representatives upon death, lunacy, or bankruptcy, and any person otherwise deriving title from him, who will respectively have the right to receive compensation for any of his improvements. We have already seen that "landlord" means "any person for the time being entitled to receive the rents and profits of any holding." There only remains for present notice the concluding provision in the interpretation clause that,

though a tenancy may have determined, the relationship of "landlord" and "tenant" will continue to exist, and the names respectively will apply, for technical purposes of all claims made or proceedings taken to obtain compensation under the Act (§ 61).

General Right of Tenant to Compensation (§ 1).—Having thus to some extent cleared the ground, we can now go back to Section 1 of the new Act with better chances of understanding it. Interpretation clauses used to come early in an Act as guides to the meaning of the terms used in it. Modern draftsmen often place these among the concluding sections, for in passing the Bill it is necessary to postpone them until the main provisions have been settled.

A tenant, then, who has made on his holding any one or more of the foregoing twenty-three improvements, became entitled, on and after January 1, 1884, "on quitting his holding at the determination of a tenancy," to "obtain from the landlord as compensation such sum as fairly represents the value of the improvements to an incoming tenant;" provided that, in estimating the value of any such improvement, "there shall not be taken into account as part of the improvement made by the tenant what is justly due to the inherent capabilities of the soil."

It will be seen that, contrary to the corresponding provision of 1875, compensation cannot be claimed by the sitting tenant upon a determination of the tenancy; he can only claim if he quits his holding. This point was much discussed when the Bill was pending in Parliament, and the discussion has continued since the Bill became law. One class of critics contend that, on the determination of a tenancy, the sitting tenant ought to have been protected against a rise of rent, justified perhaps only by his own improvements. On the other hand, it is contended that no such safeguard could really have been afforded except by a system of judicial rents, as in Ireland. A continuing tenant, on the renewal of his lease, takes out of the soil the value of his own improvements, or otherwise enjoys the advantage of them. If he is also compensated by his landlord, he is paid twice over, in money and in kind, for the same thing. In self-protection, landlords would certainly recoup themselves for having to pay such compensation by a corresponding increase of rent; in fact, the property in the improvements would pass to the landlord, and he would thereupon be fairly entitled to charge it on the rent. A man cannot in reason expect to play at the same time two parts, that of the tenant who goes, and is then properly paid for what he leaves behind; and that of the tenant who stays, and who then gets back his own

again. Meanwhile, a sitting tenant enjoys substantial protection against any undue rise in rent, by reason of the compensation for disturbance to which the landlord at once becomes liable if the tenant resists a rise in rent and quits his holding.*

"Determination of tenancy," it may here be convenient to explain, means throughout the Act an end put to a tenancy by effluxion of time or any other cause (§ 61), such as death or bankruptcy. In cases where a tenant has renewed his tenancy upon its determination from any cause, his title to compensation holds good when he quits his holding, although the improvements for which he claims may not have been executed during the last expiring tenancy (§ 58). There is an obvious justice in securing to such a tenant a continued right to the fruits of his outlay, and this provision very properly removes all the technical objections which might otherwise have defeated his claim. For the purposes of this section, the two months' notice of claim, which must be given to a landlord "before the determination of the tenancy" (§ 7), must be read as referring to the last-expiring tenancy, and not to that in which the improvements were actually made.

We come next in the wording of § 1, to the person liable to pay a tenant's compensation. In law, though not in practice, this liability rests on the landlord. No one may be willing to rent the farm; in any case, an incoming tenant is merely a substitute provided by landlords to meet claims which otherwise they would have to satisfy. The landlord's responsibility fully appears in the Act; it is not a new responsibility, but, seeing the present dearth of tenants, any practical increase of it can hardly be viewed by landlords with a light heart. As everybody knows, but as a good many people are apt to forget, tenant-right has two sides; and more than justice to the outgoing tenant means injustice and crippled resources to the incoming tenant. In the new order of things, which seems within measurable distance, when landlords will be competing for farmers instead of farmers for land, it is easy to imagine a newcomer refusing point-blank to have anything to do with the outgoing tenant. "I don't believe the improvements are worth what the valuers say they are worth; the sum they fix is out of the question. I won't give more than so-and-so. If you want me to rent your farm, you must pay out your late tenant, as the Act says you must, and take from me what I think fair value for his outlay."

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* See the able defence of the Act, already quoted, by Mr. Shaw-Lefevre, who had charge of the Bill in the House of Commons.

What is the sum fairly representing the value to an incoming tenant of any one or more of the twenty-three improvements specified in the Act, after deducting in respect of each "what is justly due to the inherent capabilities of the soil"? Such is the knotty problem which Parliament has set to valuers, referees, and umpires.

The basis of compensation under the Act of 1875 was outlay by the tenant, limited to periods of twenty, of seven, and of two years, after which periods first, second, and third-class improvements respectively were held to be exhausted. It was for the valuers in each case to say, as they are still required to say in cases in which that Act remains operative, whether within the specified limits of time the improvement was or was not exhausted. A tenant acquired no absolute interest extending over the maximum period applicable to the three classes of improvements. In the absence of agreement it was for the valuers, when a tenancy expired, to fix the term of life, if any, which was still left to an improvement. The tenant was paid in respect of that unexhausted term, but the valuers might find that the improvement was exhausted, in which case he would receive nothing, though the maximum period applicable to it under the Act had not yet expired. Thus the valuers' task was not an easy one, nor could they always award just compensation, even when they found the improvement still alive. On this point, a valuable note, appended by Mr. J. D. Dent to my remarks in the 'Journal' on this part of the Act of 1875, may here be quoted:—"In the laying down of land to permanent pasture, the making and planting of osier-beds, making of gardens, of fences, planting hops, orchards, reclaiming waste land, it is quite manifest that, for some years after the cost of the improvements has been incurred, there can be no appreciable return to the tenant; while, during the latter period of the twenty years, the return may be almost sufficient to recoup the whole cost of the operation. The tenant, therefore, whose tenancy comes to an end during the earlier period after such an improvement has been executed, will not really be reimbursed for his outlay in the same proportion as the one who has continued to occupy until the remunerative return has commenced."

It must be admitted that, in principle, compensation on the basis of value to an incoming tenant is fairer than compensation awarded on the basis of, it may be, ill-advised expenditure by the outgoing tenant, as provided in 1875. We see that the methods for awarding compensation there prescribed were not quite so simple as they looked, and did not depend on an easy sum in arithmetic; while, as Mr. Dent showed, they could not always be trusted as equitable in practice. But the difficulties

of the situation are not less in 1884. No period of exhaustion is fixed for any improvement. Valuers will not now be controlled by definite rules as to limit of time and tenant's outlay. So far, however, the experience and intelligence of valuers may be safely trusted for dealing with any questions that may arise with a sort of rough justice, and by the light of common sense. Every day, under local customs or agreement, they have to assess the value to incoming tenants, of acts of husbandry, manuring, and drainage. Such questions are familiar to them, and are disposed of without much friction. Under the new law no material differences are likely to arise concerning permanent improvements; for these will hardly ever be made by tenants except under agreements specifying the compensation to be given for them. Drainage, too, as will presently appear, will generally be provided for in like manner under the alternative powers given by the Act; so that the chief business of valuers will be that of assessing compensation for the eight temporary improvements, which involve points of everyday practice.

A difficult duty, however, now cast upon valuers is that of distinguishing for what part of any improvement a tenant shall receive compensation, and what part "is justly due to the inherent capabilities of the soil." Here again we may expect that, as to permanent improvements and drainage, valuers will rarely be called upon to make such an apportionment. If this be so, their task will be considerably lightened. Even then complicated questions enough will arise as to the results of boning, chalking, clay-burning, claying, liming, marling, and manuring. When any or all of these improvements have been made upon different kinds of soil, with materials and manure varying in quality and price, applied with different degrees of skill, and varying also in their manurial value in wet or dry seasons, what share of the compensation must be credited to the tenant for skill and outlay, and what to the owner to whom belong the inherent capabilities of the soil? So wide a question may well present itself in different ways to different minds; and, at first sight, it would seem to present wide openings for dispute and litigation. "The inherent capabilities of the soil," it has been said, are what the tenant pays for in his rent; they ought not therefore to be used as a set-off against his improvements. True, he pays for them in his rent; and so long as he continues to pay rent he continues to enjoy them. When he ceases to pay rent, he has no right to take away with him in cash the value due to inherent qualities of the soil, whatever such value may be; this must be left behind for the benefit of the new rent-payer. Such seems to be the purport of the Act.

The question is how to reduce the words of the Act into practice. Lawyers may well give up such a task in despair. It is a question from which Courts of Law, if they have any option, will shrink instinctively, declaring it, with one assent, to be a question for reference to experts. Yet, if experts themselves differ, we may be sure that, in one form or other, the Courts will have to puzzle out this question for themselves, and construct some general principle out of facts and evidence laid before them by experts.

To an outsider it would appear that each case must differ from nearly every other; that landlords can contribute no data for a sound decision; and that the only certain materials for such a decision are those which tenants can furnish in dates and details of outlay, and its results, as tested by the actual condition of any improvement made upon the surface, and by the condition of the land and crops in proof of what remains for the incoming tenant of money sunk in the soil. We turn again to the trained valuers, who must determine what deduction should be made from the sum so found to represent the landlord's share in right of the inherent capabilities of the soil. Upon this point I cannot do better than quote the opinion of Mr. T. S. Woolley, a surveyor and land-valuer of great experience, in his opening address as President of the Surveyors' Institution * :—

"Apart from points of doubtful construction, and the grievous absence of guarantees against fraudulent claims for imaginary improvements which characterize the Act, I do not myself anticipate that any cases of serious difficulty or very great injustice will arise under it, except in relation to the question what proportion of any given amount of improved value is due to the intrinsic or inherent qualities of the soil. I say frankly that, notwithstanding the experience I have acquired during the assiduous practice of my profession for well-nigh half a century, I distrust my own power of determining it with anything like perfect certainty. This would be true even in cases in which the amount of the improved value had been approximately ascertained; that problem itself being absolutely incapable of solution, except on the impossible assumption that every one concerned approached the consideration of it with full knowledge of the facts and perfect freedom from bias, to say nothing of dishonest intentions. Having spoken with such candour of my own shortcomings, I venture to express, with equal plainness of speech, my absolute conviction that most of the existing class of tenant-right valuers, by whom those questions will presumably have to be dealt with, are at least as ill-qualified to deal fairly

* Vol. xvi. 'Transactions,' Part I.; November 12th, 1883.

with them. Nevertheless, by the time that tenant's improvements, of a spontaneous and unrequited kind, have become common—and, without undervaluing a class in whom I feel the strongest personal and indeed hereditary interest, I say they have not been so hitherto—some more or less satisfactory rules of practice will probably have been pretty generally accepted."

In other words, even men accustomed by life-long training and experience to fix tenant-right compensation will have to grope very much in the dark for rules of practice; and the acknowledged head of the profession can only assume that these rules, when found, will be "more or less satisfactory." Mr. Woolley proceeded to deal with a hypothetical case, in order to contribute his share towards the adoption of a fair working rule. It is a case of permanent improvement, No. 12, reclamation of waste land, and may be thus shortly put:—A peasant employed at weekly wages leases a cottage and acre of garden on the edge of a moor, and during his evenings and spare hours brings into cultivation a portion of moor-land, thereby raising the rental value of his holding in the course of fifteen years from 5*l.* to 20*l.* Allowing for the winter months, for Sundays and other non-working days, as well as for harvest and other seasons during which he could have no leisure, an average of three hours per day for 200 days would be a very liberal estimate of time devoted to reclamation, and not occupied in working elsewhere for wages, or in ordinary acts of husbandry for himself. The value of this labour, equal to sixty days of ten hours each, is set down at 3*s.* 6*d.* a day, representing an aggregate yearly value of 10*l.* 10*s.* This sum, accumulated for fifteen years, with interest at 5 per cent. (an "extravagantly favourable" allowance for the tenant), amounts to about 226*l.* But the supposed increase in the value of the holding during the fifteen years is 450*l.*, arrived at thus:—

	£
Improved yearly value, 20*l.*, at 30 years' purchase	600
Original value, 5*l.*, at 30 years' purchase	150
	£450

If the peasant quits his holding at the expiration of his lease, to whom belongs the difference between this sum of 450*l.* and the 226*l.*, a very liberal estimate of his contributions towards it? Mr. Woolley replies, "Obviously to the landlord, because the dormant value, or capability of development, is his, both as a matter of abstract right, and according to the provisions of the Act, being 'justly due to the inherent capabilities of the soil.'" In this calculation "no account is taken of the benefit which the tenant derived from the cultivation of the holding during his

fifteen years' tenancy, because that would not be in accordance with the principles of the Act." Mr. Woolley adds:—

"It may perhaps be taken to indicate, as a rough-and-ready general rule, to be modified according to circumstances, that of any capital sum, representing the increased value to the incoming tenant, accruing from, or, to speak accurately, developed by, the outgoing tenant's outlay, about half should be held to belong to the latter, and half to the landowner." *

Such a basis of apportionment, publicly suggested to his fellow-valuers by a gentleman of position and acknowledged authority, is an important step towards a solution of the problem set by Parliament. It may be added that, in the discussions which afterwards occurred at the Surveyors' Institution on the same question,† the President's suggestion was accepted by valuers of experience, as affording a fair and reasonable basis of settlement, subject of course to any special circumstances which may occur in particular cases to modify any general rule.‡

Differences of opinion, however, prevailed. Another suggestion there made for a proper basis of apportionment may be stated thus:—Find out the value of an improvement to the incoming tenant, and the outgoing tenant's outlay upon it. The compensation to the outgoing tenant will be based upon that outlay; the surplus, large or small, belongs to the owner. An extreme case was put to illustrate the working of this rule. A 20-acre field, situated on a slope, is bounded at the bottom of this slope by a bank which prevents the water from draining through its natural outlet. In this water-logged state the field is worth no more than a shilling an acre. The tenant employs a labourer, who in one day, by digging a channel through the bank, finds vent for the water, and the field, being thus effectually drained at the cost of half-a-crown, becomes worth 21*l.* instead of 21*s.* a-year. How will you apportion this improved yearly value when the tenant quits his holding? Answer: the measure of his compensation is his actual outlay; all the rest belongs to the landlord, being due to the inherent capability of the soil. So:—

	£	*s.*	*d.*
Improved yearly value, 20*l.*, at 30 years' purchase ..	600	0	0
Outlay of tenant on improvement	0	2	6
	£599	17	6

Leaving as compensation for the outgoing tenant not 300*l.*, one-half the improved value, but 2*s.* 6*d.*; while the landlord

* 'Transactions,' vol. xvi. pp. 4–7.
† Ib., 'Proceedings' of December 3, 1883.
‡ Ib., 'Proceedings' of December 17, pp. 82–3.

takes 599*l.* 17*s.* 6*d.*, because the tenant's outlay of 2*s.* 6*d.* has merely developed what was latent in the soil, and he has enjoyed the improved yearly value of the land during his tenancy, which is the substantial advantage to which he really looked in making the improvement. Applying the principle here set forth to manures, "an outgoing tenant would only be entitled to the equivalent of the *cost* of the manure left in the land; that is, the sum by spending which in manure the incoming tenant might be supposed able to do as well for himself. This sum would be the maximum, because if the result attained were more, it must be due to the capabilities of the soil. On the other hand, if it were less, that would be through the outgoer's want of judgment, and he would suffer accordingly. This relieves the valuers from ever having to consider what a farm was worth to rent either at the beginning or at the end of the tenancy, and gets rid of many of the difficulties, though it has not removed them all."

We may now pass from the general scheme of compensation under the new law, and consider some of its more important details.

As to Improvements executed before the Commencement of the Act (§ 2).—Though, as a rule, compensation cannot be claimed for improvements executed before January 1, two exceptions occur in which the Act is retrospective. These exceptions are in favour of (*a*) tenants who within ten years before January 1 manured their holdings, or made any of the six other temporary improvements in Schedule I., and yet have acquired no right to compensation in respect of them under agreement, custom, or the Act of 1875; and (*b*) tenants who within the same period, having in like manner no right to compensation, executed permanent improvements or drainage-works.

In case (*a*), claims may be made irrespective of the landlord; a new contract of tenancy is, in fact, fastened upon him, which neither party contemplated when the tenancy began, and under which claims may be made going back for ten years, however clear the bargain to the contrary. It looks an ugly blot on the Act, for it allows a tenant to go back from his word, or even his bond. In the circumstances specified, the tenant's right to compensation is absolute. The landlord's protection is that there must be proof of value to an incoming tenant. He may also escape from this unforeseen liability if he can show that the farm was let under its value, conditionally on the making of the improvements claimed for, because, in making the award, there is to be taken into account, in reduction of the tenant's claim, "any benefit which the landlord has given or allowed to the tenant in consideration of the tenant executing the improvement" (§ 6). It is to be assumed, however, that clear proof

must be given of valuable consideration; mere proof, for instance, of a low rental in comparison of real value would be insufficient unless accompanied by an express agreement that such rent was in consideration of the improvements. The House of Commons, in their reasons for disagreeing with Lord Salisbury's amendment to this clause, expressly justified the retrospective contravention of existing agreements, on the ground that there was no reason for distinguishing between cases in which the tenant's compensation was excluded by express contract, and those in which it was excluded, without contract, by implication of law. It will be strange, indeed, if we do not find this argument used hereafter for purposes which would, at present, shock no persons more acutely than some of the framers of the Agricultural Holdings Bill themselves.

What an unscrupulous or dishonest tenant may claim under § 2 is one thing; what he can recover is another. Probably under the conditions of proof as to unexhausted value of his outlay remaining in the soil, and subject to the sets-off in § 6, the practical effect of the provision under notice will be small. Its principle, however, and the power it gives to unscrupulous tenants, or interested persons behind them of (to use a common phrase), "trying it on," and involving landlords in uncalled-for litigation, are not easily defensible. The second provision applicable to permanent improvements and drainage is properly safe-guarded. There no claim can be made unless, before January 1, 1884, the landlord by writing ratifies the making of such improvements; in other words, creates a claim to compensation where no previous right whatever existed. Then a vested interest accrues to the tenant, who, on quitting his holding, will, in common with the tenant entitled to claim for temporary improvements, receive such compensation, if any, as the Act gives, as though it had been in force when the improvements were made.

As to Improvements executed after January 1 (§§ 3 and 4).—It will be remembered that, as to temporary improvements, tenants now are free to make them without asking leave or giving notice; in this, as in other cases, subject of course to agreement, the restrictions upon which will be explained presently.

Owners retain the right of preventing the execution of any works which may change the character of their property. No compensation, therefore, can be claimed for permanent improvements unless the landlord, or his authorised agent, has in writing consented to the making of them before they were made; and such consent must have been given since January 1. It may be given unconditionally, in which case compensation will hereafter be paid as the Act provides; or it may be given

"upon such terms as to compensation or otherwise as may be agreed upon," in which event compensation under the agreement, if adequate, will be substituted for that claimed under the Act (§ 3).

A condition precedent to the claim for compensation in respect of drainage (§ 4) is, that not more than three, and not less than two months before beginning this improvement, a tenant shall give to the landlord or his agent a written notice, not only of his intention to drain, but of the manner in which he proposes to do the work. On receiving these particulars the landlord has the following options:—

1. If satisfied with the mode of drainage proposed, he can agree with the tenant on the terms, as to compensation "or otherwise." These words imply a power to arrange by lowering rental in consideration of the work, by finding materials while the tenant finds labour, or by making some other equivalent to the tenant in total or partial lieu of compensation. If such an equivalent be substituted, the arrangement so agreed upon will over-ride the compensation prescribed in the Act.

2. If the landlord is not satisfied with the mode of drainage proposed, or if for other reasons he thinks it better to keep the work in his own hands, he can himself undertake to execute the improvement, charging the tenant with an addition to the rent of not more than 5 per cent. interest on his outlay, or with an annual payment which will be recoverable as rent, and will extinguish this outlay in twenty-five years, including interest at the rate of 3 per cent.

3. The landlord may, if he thinks fit, dispense with notice, and contract with the tenant under lease or agreement, that the latter shall execute drainage works, with fair terms as to compensation or otherwise.

Thus, although the landlord cannot veto drainage, he can practically control it. On notice, he becomes seized of the work, and may make the tenant responsible in increased rent for an outlay much beyond that which the tenant expected. For example, suppose, in a case which has been put, the tenant thinks that bush-drainage would answer his purpose, while the landlord thinks that, if there is to be drainage, it should be done thoroughly, with tile-drains four feet deep. Apparently to meet any such divergence of views, the tenant may withdraw his notice on learning what his landlord proposes. On such withdrawal the landlord's power to undertake the work ceases, if it has not then been exercised. It is true that, to guard against any too lavish expenditure by the landlord, § 4 stipulates that, if he elects to carry out the drainage, he must do so in a "reasonable and proper manner." Apart, however, from the

difficulty of determining what these words may mean in given cases, it is clear that a tenant's notion of what is reasonable and proper may differ materially from that of a landlord's. The provision for spreading repayment of outlay over twenty-five years points to a loan or charge on the estate by the owner, and in this case the work must be thoroughly done.

Good sense and good feeling on both sides should prevent any collapse of the proposed drainage if it be really required for the proper cultivation of the holding; and in such a case landlords ought not to use their power under § 4 for the purpose of frightening tenants into the withdrawal of their notices. Before giving any notice a sensible tenant who is on good terms with his landlord, will, it may be assumed, consult the landlord or the agent as to the kind of drainage he proposes, so that there may be no unpleasant surprise on either side. In any case the notice must give clear information of "the manner in which he proposes to do the intended work," so that the landlord may have before him the proper materials for deciding upon the merits or demerits of the plan. Having supplied this information, the tenant must take care to carry out the work in conformity with it, or he may hereafter fail to obtain compensation. The object of this section is to give the landlord an opportunity, if he thinks fit to use it, of himself taking in hand works which trench so nearly upon ownership, instead of leaving them to another person; and for this purpose the Act holds it to be essential that he should know not only what is proposed to be done but how it is to be done. If, therefore, he lets the tenant proceed with the work, it is presumably because he is satisfied with the manner in which the tenant says it will be executed. It follows that, by any material departure from the plan mentioned in the notice, the landlord will lose his statutory protection, and the tenant runs the risk of losing, in turn, his claim for compensation, never having in fact satisfied the landlord in the terms of the statute.

In exercising their powers with regard to permanent improvements and drainage, tenants must ascertain that notice is only given to agents "duly authorized in that behalf;" that is, agents expressly authorized to receive and act upon such notices. Service under sections 3 and 4 on an agent whose powers, for instance, were limited to the receipt of rent would not bind the landlord. And attention must be called here to a peculiar wording of the Act which may prove embarrassing both to landlords and tenants. The definition of "landlord" given in 1875 included "the agent authorized in writing to act under this Act generally, or for any special purpose." There is no definition of this kind in the new Act: §§ 3 and 4 are the

only sections in which agents are mentioned, and then only for the purpose of signifying the consents and receiving the notices there specified. According to a well-known rule of construction, this express mention of agents as having powers for a special purpose, would exclude them from the exercise of powers in other parts of this Act where landlords are mentioned alone. Tenants, therefore, must bear in mind that, in all cases except those just referred to, the Act brings them into direct relations with their landlords, to whom all the formal notices and other communications required by the Act must be addressed.

Section 4 provides in the tenant's interest that the landlord's undertaking to execute the drainage must be carried out "within a reasonable time," whatever period this may cover. When is the undertaking itself to be given? Presumably at any time within the three or two months after which the tenant may begin the work. It will be hard if the landlord delays to give the undertaking until the tenant has been forced to buy materials and engage labour. On his side the tenant must begin the work before three months have passed after he has given notice of it, or he will have to serve a fresh notice and begin again. It will be understood that, in default of any agreement, or intervention of the owner, after notice, the tenant may do the work, and will then become entitled to compensation under the Act.

As to Agreements.—It may be assumed with some confidence that the effect of §§ 3 and 4 will be to force landlords and tenants into specific agreements in most cases (and in England these are not numerous) in which the former allow their tenants to make permanent improvements, or execute works of drainage. In such cases valuers will not meet with the difficulty of sharing the improved value of a holding between landlord and tenant, but they will be confronted with another difficulty hardly less serious.

The view taken by Parliament being that tenants cannot be left to protect themselves in dealing with their landlords, it was necessary to make void all agreements forced upon tenants with a view to oust the Act. Parliament does not forbid agreements, but controls them, so as to secure for tenants not necessarily the exact statutory compensation now provided, but such adequate return for their outlay as will satisfy the spirit of the Act. On some holdings, and under special circumstances, especially in executing permanent improvements, the new law contemplates that it may be well for landlords and tenants to make their own arrangements. But lest the policy of the Act should be defeated by the permission thus given, "any contract, agreement, or covenant will be void," so far as it deprives a tenant of his right to compensation for any of the specified 23 improve-

ments, unless it be "an agreement providing such compensation as is by this Act permitted to be substituted for compensation under this Act" (§ 55). It will be seen that the whole contract is not voided, but only such parts of it as would contravene the statute.

One might naturally suppose from the words just quoted that we should find elsewhere in the Act some formula of substituted compensation. This is not so. Such light as is thrown upon the intention of Parliament must be gathered from the language of §§ 3 and 4, and from the "reservation" as to existing and future contracts of tenancy (§ 5).

We have already seen that in the event of any agreement being made between landlords and tenants under §§ 3 and 4, with regard to permanent improvements or drainage, "any compensation payable thereunder shall be deemed to be substituted for compensation under this Act." The landlord, therefore, can forbid all permanent improvements, or can allow some, forbid others, and make his own terms. He can take the drainage into his hands or agree for its execution by the tenant; any such agreement is recognized as binding by § 55 read in connection with §§ 3 and 4. The "reservation" as to existing and future contracts of tenancy will now be considered (§ 5).

This section consists of three paragraphs, the first and third of which refer to contracts of tenancy current on January 1, 1884; the second to contracts of tenancy beginning after January 1. Dealing first with contracts of tenancy current on January 1, § 5 enacts that if in these cases tenants can obtain "specific compensation" for any one of the 23 scheduled improvements, whether by virtue of a written agreement, or of custom, or of the Act of 1875, this specific compensation for such improvement "shall be deemed to be substituted for compensation under this Act," though the improvement may have been executed after January 1. It follows that, if the tenant has executed several improvements, and is entitled by agreement, custom, or statute, to specific compensation in respect of no more than one, the agreement, or custom, or statute, only prevails to that extent; the tenant may claim under the Act in respect of the rest. This right would be subject to two conditions: (1) that if the tenant has received notice to quit, he can only manure his land, and can make no other improvements; (2) that in the case of temporary improvements, duly executed by a tenant after January 1, and for which he cannot claim *specific* compensation, the Act will be superseded by any agreement into which he may have entered with his landlord giving him *general* compensation, provided that such compensation is "fair and reasonable,

having regard to the circumstances existing at the time of making such agreement."

With regard, therefore, to tenancies current on January 1, 1884, it appears that if the tenant cannot obtain specific compensation, by custom or statute, for improvements duly executed by him after that date, all existing agreements, so far as they relate to such improvements, will be affected as follows:—

(1) If the agreement provides specific compensation for one or more improvements, but is silent about compensation for any other improvements, the tenant can claim compensation under the Act in respect of those other improvements.

(2) If the agreement provides specific compensation for certain improvements, and general compensation for other improvements, then the agreement prevails as to the specific compensation, but as to the rest will fail, so far as it applies to temporary improvements, unless the general compensation it gives for them be fair and reasonable, and compensation to that extent may then be claimed under the Act instead of under the agreement.

(3) If the agreement applies wholly to temporary improvements, without giving specific compensation for any, it will be void altogether unless it satisfies the same condition by giving a fair and reasonable compensation. In that event also the tenant may claim compensation under the Act.

Thus, if the construction here submitted be correct, an agreement entered into before January 1 may be supplemented, or may prevail in whole or in part, or may become void in whole or in part, by virtue of retrospective legislation.* It should be remembered, too, that the section applies to leases as well as to

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* A member of the Council having put some questions as to the effect of the Act on yearly tenancies with agreements for compensation which were current at the commencement of the Act, Mr. Clifford, in reply, illustrated the principles which he has expounded above as follows:—

1. At the period prescribed in Section 6, when existing agreements become affected by the Act, such agreements remain in force, subject to the compensation given by the Act where no compensation, or no adequate compensation, is given by the agreement.

2. When the Act takes effect upon an existing tenancy, I think an outgoing tenant might, in the case put, claim the specific compensation provided for in this agreement, and might also claim for other purchased food under the Act. In the latter case, under the special circumstances mentioned, [viz., where an excessive compensation was agreed to be given for oilcake and linseed *in lieu* of compensation for other purchased food], the landlord might properly claim a set-off (Section 6 (*a*)).

3. Any scale of allowances which can be shown to be "fair and reasonable" (Section 5) would not be in contravention of Section 55. The object of the restriction mentioned [that the tenant can only claim for quantities which shall not exceed the average of three years previous to the last year of the tenancy] appears to be a fair and reasonable one, and does not oust his claim to compensation, but only subjects it to equitable conditions.

yearly tenancies. This provision as to improvements executed *after* the commencement of the Act is a complement to the retrospective enactment (§ 2) giving tenants like security for improvements executed *before* the commencement of the Act. It can only apply to permanent improvements and drainage if the landlord stands by and neglects to avail himself of the safeguards furnished by §§ 3 and 4. As to temporary improvements, one of the first results of the Act may possibly be the service of many notices to quit, the effect of which will be (§ 59) at once to prevent a yearly tenant from claiming compensation for any temporary improvement afterwards made by him, except for manures, that is, as the Act defines "manures," in Nos. 22 and 23 in the Schedule. Section 59 also lays down the general rule that yearly tenants cannot obtain compensation for temporary improvements (except manures) made within one year before they quit their holdings, or lessees within one year before their leases expire. With all these checks upon the operation of this retrospective enactment, its practical effect will probably be small, at all events in the case of yearly tenancies; and it is questionable whether for such results it was worth while to make so serious a departure from sound principles. However this may be, it will be necessary to bear in mind the effect of § 5 upon all current contracts of tenancy terminating after January 1, 1884.

We come now to contracts of tenancy beginning after January 1, 1884. Here § 5 is expressly limited to temporary improvements made after that date, and it enacts, as in the case of current tenancies, that the agreed compensation for such improvements shall only "be deemed to be substituted for compensation under the Act" if it is a "fair and reasonable compensation, having regard to the circumstances existing at the time of making such agreement." In other words, a yearly tenant or lessee is to be relieved from a bargain deliberately entered into, and acted upon probably for years without complaint, if, when he leaves his holding, he or his representatives choose to say that the agreement was not so favourable to him as it ought to have been!

But what is "a fair and reasonable compensation, having regard to the circumstances existing at the time of making the agreement"? This is the difficult question which valuers will have to answer. It is eminently a question for experts. The Courts of Law have no means of deciding it except upon skilled evidence. The Lincolnshire land agents and valuers, through their Association, acting in concert with the Lincolnshire Chamber of Agriculture, have adopted the following scale of allowances as "fair and reasonable compensation" for the eight

temporary improvements in Part 3, and for draining in Part 2 of Schedule I., and they suggest that this scale should "be substituted, by agreements, for compensation under the Act":—

"1. For one-third of the cost of linseed-cake, cotton-cake, rape-cake, or malt-culm, and one-sixth of the cost of corn-cake, malt, or other manufactured feeding-stuffs of similar manurial value, which have been consumed on the farm during the last year of the tenancy; and for one-sixth of the cost of linseed-cake, cotton-cake, rape-cake, or malt-culm, and one-twelfth of the cost of corn-cake, malt, or other manufactured feeding-stuffs of similar manurial value, which have been consumed on the farm during the preceding year of the tenancy.

"2. For the cost of dry bones used with green crops consumed on the farm as follows, viz.:—the whole cost (inclusive of railway or water-carriage) if used during the last year of the tenancy, and half the cost if used during the preceding year.

"3. For the whole of the cost of artificial manures, of approved manurial value, used with green crops consumed on the farm during the last year of the tenancy, and for the cost of railway or water-carriage of the same.

"Provided that the allowances under clauses 2 and 3 for the cost of bones and artificial manures shall not exceed the cost per acre of the two next preceding years.

"4. For the cost of lime used on the land of the farm, including the cost of carriage, cartage, and spreading thereof, on a seven years' principle, that is to say, the allowance to be reduced by one-seventh part every year until the seven years have expired.

"5. For the cost of claying, marling, or chalking the farm, on a twelve years' principle, the whole of the cost being allowed for the first four years, and after that period one-eighth part to be deducted yearly for the remaining eight years.*

"6. For the cost of bones used on pasture-land of the farm as follows, viz.:—

"For dry bones, on a ten years' principle.

"For dissolved bones, on a five years' principle.

"7. For two-thirds of the cost of other purchased manures used on pasture-land of the farm during the last year of the tenancy, and for one-third of the cost of any such manures used during the preceding year.

"Resolved—That in default of any agreement or undertaking, or in the event of any other failure referred to in Section 4 of the Act with regard to improvements under Part 2 of Schedule I.,† the following allowances are, in the opinion of this meeting, fair and reasonable, viz.:—

"For the cost of under-draining the farm, as follows:—

"(*a*) When the landlord finds the tiles and the tenant the labour, on a ten years' principle.

"(*b*) When the tenant finds both tiles and labour, on a fifteen years' principle."

The Resolutions embodying this scale of allowances were passed unanimously at a united special general meeting of the bodies referred to, and are signed "M. E. G. Finch-Hatton, Chairman of the Lincolnshire Chamber of Agriculture; James Martin, President of the Lincolnshire Land Agents' and

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* "It is considered that the tenant does not receive any benefit for the first four years."

† Draining.

Tenants' Right Valuers' Association." They are a valuable contribution towards a settlement on an equitable basis of claims arising under the Act. Mr. Martin believes that this scale of allowances will be embodied in nearly all the farm-agreements in Lincolnshire; and that in this case "landlords will be quite safe from any attempts on the part of unprincipled tenants to make Section 5 suit their own purpose, for no judge will, in view of this scale being generally adopted in the county, entertain any motion to set aside an agreement containing it." The scale, if adopted, will also, as he points out, get rid of the necessity of defining what is meant by the "inherent capabilities of the soil;" and in his opinion it already supplies, in Lincolnshire at least, a safeguard against unfair interpretations of the Act.*

It is a question, however, whether any such fixed rules of compensation could be adopted for general application. A safer guide would seem to be the compensation given in these cases by custom, where such exists, for custom is accepted by the Courts as a local law based on what experience has shown to be necessary and reasonable as between landlord and tenant in the varying circumstances of different localities. In all these cases "the inherent capabilities of the soil" comes in as a disturbing element to be estimated in any basis of valuation. An opinion has been expressed that this deduction from the value of an outgoing tenant's improvements to his successor "need not in practice affect the improvements numbered 22 and 23 in the schedule,"† namely, manuring. It may be so; but until the working of the Act has been tested by practice and authoritative decision, this and other points of novelty in farm-valuations must needs be doubtful. The powers of valuers under this and other sections must be left for separate treatment in the provisions referring to them.

As to Improvements purchased by Incoming Tenants (§ 56).—For his own security an incoming tenant, if he treats directly with his predecessor, should obtain the landlord's written consent to the payment of any compensation for improvements under the Act. Otherwise he will be unable to claim from his landlord, on quitting his holding, in respect of such improvements. This provision is probably meant to prevent collusion between the outgoer and incomer, the latter of whom, quitting his holding as soon as possible after taking it, might claim compensation upon the basis of extravagant or fraudulent payments, though it does not follow that he would make good

* 'Transactions,' Surveyors' Institution, vol. xvi. pp. 65–7.

† Resolution passed by Central Chamber of Agriculture, December 12th, 1883.

his claim. As the landlord is primarily liable for any compensation, it is only right that he should know of and assent to any arrangement which may hereafter serve as a basis of claim against him. On the other hand, it is fair that there should be a recognition of the new tenant's continuing property in improvements, not, indeed, made by him, but purchased by him. Of course, as to them he stands in his predecessor's shoes, and can only obtain compensation for these improvements on proof of their value to the incoming tenant, and to the extent of that value. There is no express provision requiring the landlord to consent in the case contemplated by the section; but it is submitted that this consent must be withheld, if at all, upon reasonable grounds, and could not be properly withheld upon a decision arrived at by valuers under the procedure sections. The landlord, however, would have a clear right of refusing his consent to any compensation merely agreed upon between the outgoing and incoming tenants.

Compensation under the Act to be Exclusive (§ 57).—A tenant is not allowed the option given him by the Act of 1875 of claiming compensation under it, or by custom or otherwise. If he is entitled to compensation under the Act in respect of improvement, § 57 bars his remedy to recover under any other title for that improvement. It follows that, in respect of improvements for which he is not entitled to claim compensation under this Act, he may recover under statute, custom, or agreement, so that a tenant may, by possibility, be able to recover compensation in two or three ways. It will be important, however, for him to remember that he may be deprived of his right to compensation altogether, unless, when entitled under the Act, he gives the requisite notice of claim two months before quitting his holding.

Restriction on Improvements by Tenant about to Quit (§ 59).—The general effect of this restriction has already been mentioned. Lessees are not entitled to compensation for any improvements, except manures, within one year before their leases expire: a yearly tenant is under like restriction, and for the same period, "or at any time after he has given or received final notice to quit." A "final" notice to quit is somewhat vague; it must mean any notice until waiver or withdrawal, so that a yearly tenant will make at his peril any improvement other than Nos. 22 and 23, after receiving notice, because he cannot know whether the notice will be waived or withdrawn.

There are two exceptions to the rule here laid down:—(*a*) When a tenant from year to year has begun an improvement during the last year of his tenancy, and, afterwards receiving notice, quits his holding at the expiration of that year. This exception, it would seem, can hardly apply in practice except in

cases where, under § 33, the landlord and tenant have agreed to abide by a six months' notice.

(*b*) When a yearly tenant or lessee has given notice to the landlord of his intention to begin an improvement, and the landlord has either assented or failed to object for a month after receiving the notice. It may easily happen that a landlord may be absent from home and return too late to object. But for the care which seems to have been taken to limit the agent's powers to specified acts in §§ 3 and 4, one would have said that the landlord might delegate his authority under this and other sections. A power of attorney might suffice, but as § 59 is drawn, one of its indirect effects may be to prevent landlords from taking more than a month's holiday.

Rules for ascertaining Compensation for Improvements (§ 6).—The general principles applicable to compensation for improvements having now been laid down, an important provision embodies the regulations to be observed in administering the Act. It is assumed that a certain sum is found to be due to the outgoing tenant, representing the value of his improvements to the new comer, after allowing for what is due to the inherent capabilities of the soil. But this sum may be subject both to deductions and augmentation.

The deductions on the landlord's side are taken from the Act of 1875, namely :—

(1) Any benefit given or allowed to the tenant in consideration of his making the improvement, such as reduced rental, materials free or at reduced prices.

(2) If any compensation is claimed for manures, the valuers must ascertain what hay, straw, roots or green crops have been sold off or removed from the holding within the last two years of the tenancy (the Act of 1875 said within the last three years), or during any shorter period if the tenancy has not lasted so long, and the amount of deduction will be the value of the manure that would have been produced by the consumption of those crops on the holding, less the amount which the tenant has spent on "a proper return of manure to the holding," in the place of the produce sold off or removed. "A proper return of manure" was the term used in 1875, and is therefore so far familiar to valuers. A tenant may be precluded by the terms of his agreement or lease from selling these crops off the holding; and the Act gives him no power to break his agreement in this respect. The principle recognized in most agreements, and embodied in the Act of 1875, is now repeated, namely, that the holding has a first claim on the crops here specified; and if they do not go back to it in the form of manure, the tenant must supply an equivalent in manure or feeding-stuff, purchased by him and brought on to the holding for use or consumption.

(3) Other deductions are for rent due, for waste committed or permitted, for any breach of the contract of tenancy, and for taxes, rates, and tithe rent-charge due or becoming due.

The landlord must be prepared with proof of all these deductions; and the tenant, too, should carefully prepare himself for any disputed matter coming under heads either of deduction or of claim, by preserving receipts and vouchers, with cost of materials and labour, recording dates of manuring and other improvements, purchases of manure and feeding-stuffs in replacement of produce sold, and any other data which may be useful in resisting reductions or supporting claims. With regard to the latter, it is true that value to the incoming, not outlay by the outgoing, tenant is now the basis of value. In theory, therefore, valuers ought perhaps to dismiss from their minds a tenant's expenditure, in determining the amount of compensation due to him, and look only to the present condition of the land and of any improvements above the surface. It is obvious, however, that, in support of a tenant's assertion as to the existing value of his improvements, what he has spent upon them, and the periods at which his outlay occurred, may prove material elements in informing a valuer's mind and enabling him to correct his opinion.

In augmentation of a tenant's compensation he, too, may allege and recover for breach of covenant or agreement by the landlord. Alleged breaches of covenant or agreement on either side will refer to specific acts not usually difficult to establish or refute, though the amount of set-off or augmentation for each breach will not be so easily arrived at; and it seems clear that there will be no set-off or augmentation unless specific damage can be proved. For example, a tenant covenants to follow a prescribed rotation of crops, and fails to do so. The contract of tenancy would ordinarily provide for re-entry on such a breach; or the landlord might bring his action. If he stands by, and does not avail himself of his special remedy under the contract, it seems clear that, when the tenancy determines, the deduction for the breach can only be the specific damage, if any, which is shown to have been caused by it.

Waste is a wide term; and a tenant must always keep in view the possibility of future deductions from his compensation on this ground, and should obtain his landlord's written consent to any act by which it might hereafter be contended that the holding was deteriorated. For example, it would be active waste if the tenant broke up old pasture without consent, pulled down or damaged buildings, cut down or injured timber, hedges, plantations, coppices, or over-cropped without a proper return to the soil. It would be permissive waste if he allowed land to become foul, if he neglected to keep in good order drains,

outfalls, water-courses, gates or fences, or to make the ordinary repairs of buildings for which he is liable. On the other hand, landlords must not sleep upon their rights, for § 6 does not allow them any set-off for waste or breach committed or permitted by the tenant "in relation to a matter of husbandry" for more than four years before the tenancy determines. Upon any serious waste or breach, therefore, notice to quit seems to be the most appropriate remedy, to be waived upon the tenant's compliance with such conditions as will reinstate the holding. The four years' limit corresponds with that in the Act of 1875. The two years' limitation will also be borne in mind. As regards the tenant, his power of recovering for his landlord's breach is not limited.

It will be remembered that in the Act of 1875 the landlord could only recover under the Act for waste or breach, and the tenant could only recover for breach, if the latter claimed compensation for improvements (§ 18, 19). The landlord could then, "by counter-claim but not otherwise," obtain compensation for the waste or breach. The effect of § 6 in the new Act appears to be to continue the same restrictions, inasmuch as it is only "in the ascertainment of the amount of the compensation" payable to the tenant for his improvements that the specified deductions and augmentations are to be taken into account. It follows, as in 1875, that if a tenant has reason to believe that the deductions which his landlord may set-off will exceed the amount of his claim, he may defeat his landlord's remedy under the Act by making no claim. But the new Act (§ 60) repeats the general saving of rights enacted in 1875, so that, unless the Act expressly provides to the contrary, the landlord may, apart from the Act, exercise any powers and enforce any rights which belong to him in virtue of statute, custom, agreement, or otherwise, in respect of "any improvements, waste, emblements, tillages, away-going crops, fixtures, tax, rate, tithe rent-charges, rent, or other things." Section 60 also contains a corresponding saving of the tenant's rights.

Procedure.

Notice of Intended Claims (§ 7).—Having set forth the general principles regulating the tenant's compensation, and any counter-claim by the landlord, the Act next prescribes the mode of setting up a claim. The procedure clauses, as already stated, are taken in substance from, and are sometimes almost identical with those adopted in 1875 (§ 20 *et seq.*). The clause now under consideration, however, requires from the tenant to the landlord a written notice of two months at least before the determination of the tenancy, of his intention to make a claim. In 1875 only

one month's notice was required. This notice is a vital one, and tenants must remember that if they omit to give it within the time specified, their right to claim compensation under the Act is gone. "When a tenant gives such a notice," the landlord may serve on the tenant a written counter-notice of his intention to make a claim in respect of waste or breach. Thus, as has been already stated, the landlord can only recover under the Act for waste or breach by way of counter-claim to the tenant's claim of compensation. The period open to the landlord for making claims is any time after the notice up to fourteen days after the tenancy determines. Lastly, each notice and counter-notice must state, "as far as reasonably may be, the particulars and amount of the intended claim." The tenant's notice will be addressed to the landlord, and not the agent. No special words are necessary, but it may run in this form:—

"SIR,—I hereby give you notice that under or in pursuance of the provisions of the Agricultural Holdings Act, 1883, I intend, on quitting my holding at the determination of my tenancy on the   day of   next, to claim compensation from you, being the landlord of such holding, in respect of the following improvements executed by me, or vested in me by purchase, namely [*Here set out each improvement, with the sum claimed for each and the date at which executed. It will be convenient, for future reference, to number each head of claim.*]"

This notice must be signed by the tenant, or, in case of his death or bankruptcy, by his executors or trustee, and dated so as to show that the requirements of the Act in respect to time of service have been complied with. There can be no excuse for not serving the notice in time, as it may be served directly after receiving the notice to quit. The only reason for delaying it is that all acts of husbandry giving a right of claim may be included. Any omission may be fatal to the tenant's right to recover compensation, not only under but outside the Act, for § 57, it will be remembered, bars his remedy to recover outside the Act compensation for improvements "for which he is *entitled* to compensation under or in pursuance of the Act." Thus, if the title in question is lost by default in serving notice, the results to the tenant may be serious. The claim may be amended or supplemented by a second notice if given two months before the tenancy determines. The landlord's counter-notice may in substance follow the same form.

As to Service of Notices (§ 28).—It may be convenient to note here the requirements of the Act as to the service of notice. Section 28 applies to all notices, requests, demands, or other instruments under the Act. Service of these may be effected

in three ways :—personally ; or by sending a written note ; or by posting a registered letter to either the landlord's or tenant's "last known place of abode." If a registered letter be sent, it will be deemed to have been served at the time when the letter would reach its destination by ordinary course of post. It will be sufficient proof of service to show that the letter was properly addressed and posted, and that it contained "the notice, request, demand or other instrument" to be served. A copy of the notice, &c., should therefore always be retained, endorsed with a memorandum of the date and mode of service.

As regards service on the tenant there is likely to be no difficulty or hardship ; he is not usually long absent from his home, and the initiative as regards notice will generally come from him. But there are many landlords who travel far and wide, and whose letters sometimes, "like panting Time, toil after them in vain." Agents are almost ignored by the Act ; tenants are bound in nearly all cases to serve the landlord with notice ; and the landlord must himself act upon the notice. In his counter-claim the Act secures him two months and a half within which to serve his counter-claim, which will, of course, be prepared by the agent. It is easy to imagine cases in which notices of intended improvements, of claims, of intention to remove fixtures, and other various proceedings by tenants, may be sent by them just after the landlord's departure on his travels, with much inconvenience to the landlord ; perhaps, indeed, depriving him in effect of the protection which the Act was meant to afford him. We may expect, therefore, that powers of attorney will be plentiful, accompanied of course, as these must be, by notice to the tenants of this delegated authority. Whether, in the face of the clear directions in the Act this delegation would hold good is a point not free from doubt. In all agreements, however, it would be useful to stipulate that when under this Act notice is required to be served on the landlord, a copy of such notice should be sent to the agent named in the agreement, and thereby authorised to receive such notices.

Appointment of Referee or Referees, and Umpire.—The landlord and tenant may, of course, agree as to the compensation due to the latter. If they do not agree, the difference is to be settled by a reference (§ 8).

If they concur in leaving the matter in dispute to be settled by a single referee, they are free to do so. Before making any award the referee may die, or become incapable of acting. In either case, or if he fail to act, for seven days after notice from the parties, or either of them, the proceedings are to begin afresh, as though there had been no appointment (§ 9, sub-sections 1 and 2).

The parties may not be able to concur in the appointment of a single referee. Each of them is then to appoint a referee, giving notice of such appointment to the other, with a like power to that just noticed, of replacing a referee in the event of his death, incapacity, or failure to act. One of the parties cannot stop the proceedings by failure to appoint, for on such failure, for fourteen days after notice, the County Court is required to act for him by appointing "a competent and impartial person to be a referee." This appointment will be made upon the application of the party who has already appointed his own referee, and upon proper proof of such failure by the other side as is contemplated by the Act. Thus, we find adequate security against a dead-lock as regards the referees (§ 9, sub-sections 3, 4, 5, and 6).

The result of delivering to a referee the letter authorizing him to act is deemed to be a submission to a reference by the party making the appointment, and neither party has the power to revoke a submission or appointment without the consent of the other (§ 12).

As the two referees may, and probably will, disagree, they are to appoint an umpire before they enter on the reference; and in case of his death or incapacity, they must appoint another. In the improbable event of failure by the referees to appoint an umpire, seven days after request, the County Court may again be called upon by either party to "appoint a competent and impartial person to be the umpire," and must make such appointment within fourteen days (§ 9, sub-sections 7, 8, and 9).

As County Court Judges had the same powers under the Act of 1875, they may by this time have lists of competent and impartial valuers to be employed in these cases; and there will now be more employment for them, as landlords and tenants cannot contract themselves out of the Act, and agreements substituted for the Act must be regulated by the standard of compensation set up by it. Sub-section 9 is an exact reproduction of § 22 in the parent Act, and ends with the same requirement, namely, "that every appointment, notice, and request, under the section, shall be in writing." This requirement is necessary with a view to the order and regularity of proceedings, for an informal appointment may vitiate an award, and with it any charge upon the holding based upon the award. But, whereas the Act of 1875 made it quite clear that this business might be done by an authorized agent, the presumption here is that the landlord must sign all these documents and receive all the notices. If, therefore, he has a large estate, he will be kept busier than probably he has ever been before, and indirectly the Act will be a check upon absentee proprietors.

Appointment of Umpire by Land Commissioners or County Court (§ 10).—Either the landlord or the tenant can require that the umpire shall be appointed by the Land Commissioners. The referees will generally be men in the district, and the same rule will apply to referees or umpires appointed by the County Court. There may be reasons why, in the opinion of one of the parties, it would be better to have an umpire unconnected with the locality; and if so, an appointment by the Land Commissioners would no doubt meet this view, though the expense might thereby be increased. The Land Commissioners are old friends under a new name, conferred by statute in 1882,* and the same duties were entrusted to them by § 23 of the Act of 1875. If either party desires that the umpire shall be appointed by the Land Commissioners instead of by the referees, he must give notice in writing to the other side in informing him of the appointment of a referee. It will be necessary also to give the same notice to the referee on appointing him, or he with his colleague may proceed to choose the umpire under § 9. If either party desires, as a middle course, an appointment of the umpire by the County Court, avoiding a choice by the referees or the Land Commissioners, this object, again, may be accomplished by a notice given to the other side when the referee is appointed, provided that both parties consent. Thus, there are more than the proverbial three courses open in this matter, for an umpire may be appointed :—

1. By the referees, if both sides consent (§ 9).
2. By the County Court, on application from either side, if the referees fail to make the appointment. This is an absolute power vested in the Court in the contingency mentioned, and is not open to objection (§ 9).
3. By the Land Commissioners, on application from either side; and here also either side has an absolute right to require this mode of appointment (§ 10).
4. By the County Court, on application from either side, unless the other side objects (§ 10).
5. In the latter case, on application from the party so objecting, by the Land Commissioners (§ 10).

It will be seen that, as under the Act of 1875, suitors may require that the umpire shall be chosen by the Land Commissioners in the case of an original appointment; but if once the referees are allowed to appoint, any substituted umpire

* "The Commissioners now bearing the three several styles of the Inclosure Commissioners for England and Wales, and the Copyhold Commissioners, and the Tithe Commissioners for England and Wales, shall, by virtue of this Act, become, and shall be styled, the Land Commissioners for England."—Settled Land Act, 1882, s. 48.

can only be chosen by them, or, failing them, by the County Court.

In the exercise of this jurisdiction, relating to the appointment of referees and umpires, the Judge of the County Court is to act, whether he is without or within his district; or, by consent of the parties, the registrar (§ 11). "County Court" here and elsewhere means "the County Court within the district whereof the holding, or the larger part thereof, is situated" (§ 61).

Powers of Referees.—We now have a tribunal duly constituted in one of four different ways, for it may consist either of a single referee, of two referees, of two referees sitting with an umpire, or of an umpire sitting alone. This is the same tribunal as was created in 1875, and the powers given to it are also exactly similar. Its first duty appears to be to give notice to the parties of its intended sitting. After such notice, it may, at its discretion, proceed in the absence of either party (§ 14). Presumably a view of the holding would be the first business which the Court would take in hand. For ensuring proper evidence, it may "call for the production of any sample, or voucher, or other document, or other evidence which is in the possession or power of either party, or which either party can produce," and which it deems necessary for determining the matters referred. But, like the corresponding section of 1875, § 13 provides no penalty for the non-production of documents; the tribunal is left with the empty power of calling for them and nothing more. Such a power may of itself suffice, as the non-production of any material sample or document might of itself be regarded as conclusive against a claim. The Court may administer oaths and take affirmations; and any parties or witnesses who "wilfully and corruptly" give false evidence will be guilty of perjury. Large powers are therefore possessed by the tribunal for arriving at the facts.

The Award.—This must be in writing, signed by the single referee, or by the two referees, or by the umpire (§ 15). If a single referee acts, his award must be ready for delivery within twenty-eight days after his appointment. If there are two referees, it must be ready for delivery within the same period after the appointment of the referee last appointed; but they may extend the twenty-eight days to forty-nine days from this date, or to any shorter period, if both concur in thinking such extension of time necessary, and jointly fix the time in writing (§ 16).

Should the referees agree upon an award, they have an obvious and usual means of recovering their fees by requiring that these should be paid before parting with their award. If, however, they disagree, and have no award ready within the period just

mentioned, their authority ceases; the matters of reference then stand referred to the umpire (§ 18), and they must sue the parties employing them in default of payment. There does not appear to be any imperative obligation upon the referees to inform the umpire that he is seised of the questions in dispute: § 18 only says that the umpire shall make his award ready for delivery within twenty-eight days after receiving from either party, or either referee, written notice of the reference to him; so that the parties may meanwhile agree to put an end to the litigation and expense that may follow the umpire's intervention. If the umpire cannot prepare his award in twenty-eight days, it will be necessary that either he or one of the parties should, within this period, apply for an extension of time to the registrar of the County Court, who may refuse the application, or extend the time again or again without any limitation.

A usual course, with a view to save expense, is that an umpire should sit with the referees, and form his own judgment upon the facts and evidence, subject to any statement he may afterwards receive from the referees, should they differ in support of their respective views. This procedure rather presupposes that the referees will differ, as indeed they generally do, being chosen to represent different interests, and therefore in a measure bound to support or oppose the claim. In practice, if there be this joint sitting, the referees would generally be able, when it closes, to say whether they agree or disagree; and the umpire would generally know whether his services would become necessary. But there is nothing in the Act to require an umpire to sit with the referees, and this, therefore, is a point left to be settled by the convenience of the parties.

Award to give Particulars (§ 19).—A similar condition was laid down by § 32 in the Act of 1875, and the valuer's work is now required to be even more precise. There must, therefore, be corresponding method and accuracy in the tenant's accounts; and he will often suffer pecuniary loss unless these are kept with a view to satisfy the exigencies of the new law. The old system of stating a lump sum for everything due to the tenant encouraged slovenly accounts; but now, as in 1875, referees and umpires are not to award "a sum generally for compensation." They must "so far as possible specify"—(*a*) the improvements, acts, and things for which compensation is awarded; (*b*) the date at which each was done; (*c*) the sum awarded in respect of each. The same details are required concerning the valuable consideration, waste, or breach pleaded by the landlord in reduction of the claim, and concerning any breach alleged by the tenant to swell it.

It will be seen that there are some saving words which carry out in spirit an old enactment:—

> "There was a law of Don Fernando—
> 'No man shall do more than he can do.'"

If the details mentioned in § 19 are not to be had by reason of the farmer's neglect or his muddled accounts, it is clear that the referees cannot give them ; and it would not be just to deprive farmers of compensation in such cases when the evidence in their favour might be clear *aliunde:* for example, in the condition of the land, as showing value to an incoming tenant. In the Act of 1875 this same consideration was given to claimants of compensation, and the particulars required were to be given "as far as reasonably may be." In the new Act "so far as possible" are the equivalent words. Tenants, however, will do well not to rely too implicitly on this loophole of escape, for, though their claims may not be barred by want of the particulars specified in § 19, they will certainly risk, by neglect in this matter, the loss of some of the compensation which might otherwise have been given to them.

(*d*) Another item usually specified in the award (though the Act does not make this imperative) will be the costs of or attending the reference. These will include the remuneration of the referee or referees and umpire, and "other proper expenses." The Act repeats the provisions of 1875 upon this point, and gives to the tribunal the fullest powers of ordering the whole or any part of the costs to be paid by one party to the other ; or of ordering payment to be divided between the parties in such proportion as they think just, "regard being had to the reasonableness or unreasonableness of the claim of either party in respect of amount or otherwise, and to all the circumstances of the case." (§ 20.) Speaking generally, the section seems to contemplate that costs will follow the event. Its effect should be to prevent either party, to use a common phrase, from "opening their mouths too wide;" for unreasonable claims or counter-claims will be punished by costs, especially if they lengthen the inquiry and involve adjournments and delay. So, too, confused and inaccurate accounts, adding, as these frequently must, to the referees' labours, and thus prolonging the reference, may properly be visited by the same punishment. If costs are not mentioned in the award, each party will pay his own. Supposing an unreasonable claim to be mixed up with others not open to the same objection, that fact would suggest payment by the claimant of so much of the costs as might thereby be fairly chargeable on him. It might, for example, appear that, but for this item in a tenant's claim, the landlord would not have

resisted the compensation demanded. Looking at the litigation and expense of which a reference may be the beginning, the obvious course for sensible men is to avoid one if possible, by reasonable demands in the first instance and mutual concession; but if, as appears to be threatened, experts should be employed to exaggerate claims and make out big bills, as when property is taken under the compulsory powers of a railway company, there is little hope of quiet settlements.

If costs are mentioned in the award, the party required to pay them may have them taxed by the registrar of the County Court, from whose decision either party may appeal to the Judge (§ 20). It will be understood that neither registrar nor Judge can, merely upon taxation, upset or vary the referees' or umpire's decision in fixing the costs on either side.

(*e*) Another part of the award must be a day fixed in it (not sooner than one month after it has been first delivered) for the payment of the compensation and costs (§ 21).

(*f*) If a landlord desires to charge his estate (under §§ 29–32) with the amount of compensation found due to the tenant, the award must specify "the time at which, for the purposes of such charge, each improvement, act, or thing in respect of which compensation is awarded, is to be deemed to be exhausted." This part of the award depends entirely upon the landlord; if he requests the referees or umpire to give these particulars, neither they nor the tenant have anything to say; and it is for him afterwards in his discretion to make the charge, or allow the compensation to be paid in the ordinary manner.

Award for Compensation under §§ 3, 4, 5.—It will be remembered (1) that, while the general right of tenants to compensation under the Act is recognised (§ 1), compensation is only payable under the Act in respect of permanent improvements upon the landlord's unconditional assent, and in respect of drainage upon the landlord allowing the tenant to execute it, also without conditions; (2) that in the event of an agreement in either case, the agreed compensation is allowed to be substituted for compensation under the Act (§§ 3, 4); and (3) that the like substitution is allowed in the case of temporary improvements made after January 1, under then existing or future contracts of tenancy, provided that the agreed compensation for these temporary improvements is fair and reasonable, having regard to the circumstances existing at the time the agreement was made, and subject, as regards tenancies current on January 1, to the condition that if the tenant has agreed for specific compensation for any temporary improvement, or can recover such specific compensation by custom or statute, this is to be the compensation he receives (§ 5).

Special provision is made (§ 17) for cases arising under §§ 3, 4 and 5. If, in these cases, tenants claim under the Act, the substituted compensation is to be awarded by the referees or umpire for any improvements provided for in the three sections, "if and so far as" this substituted compensation "can, consistently with the terms of the agreement, if any, be ascertained;" and the award, "when necessary," is to distinguish such improvements, and the amount awarded for them, and is to be subject to appeal like other awards under § 23.

The object of § 23 is not clearly expressed, but it appears to be mainly framed with a view to make awards under §§ 3, 4 and 5 correspond as far as possible in form and substance with all other awards, so that they may give rise to no difficulties on appeal. We have seen that there may be no agreements under §§ 3, 4 and 5; or there may be agreements relating to one or two classes of improvements, and not to others; or the compensation claimed may be, in part, compensation directly under the Act, and, in part, substituted compensation. In order, therefore, that the award may, on the face of it, convey all the particulars which may afterwards be essential for the information of the parties or of the County Court on appeal, the substituted compensation, if possible, is to be ascertained and to form part of the award. If there be an agreement, the referees or umpire may not be able to ascertain what the substituted compensation really is, "consistently with the terms of the agreement," which may contain reciprocal conditions not easily appraised in money. On the other hand, this appraisement will be easy if, as in the case of current tenancies, the right to substituted compensation arises under custom or statute. The substituted compensation when ascertained may be a lump sum. It may not always be necessary to distinguish the improvements for which it is given, as, for instance, if no question arises upon them; but, "when necessary"—that is, if the dispute turns upon the amount due in respect of these improvements, or if the other items of claim require that each shall be separately assessed—then the lump sum must be distributed, and each improvement must be credited with its proper share, as is required under § 19 in awards generally.

This construction of § 17 is not free from doubt. It may be contended that, as it is imperative on the referees or umpire, "when necessary" to distinguish the improvements and the amount awarded for them, the effect of the latter part of § 17 is to authorise the referees or umpire, "when necessary," to set aside the agreement if they cannot ascertain the substituted compensation payable under it, and to award in respect of each improvement as though no agreement had been made. This

construction involves a contradiction in terms between the earlier part of the section, which recognises that it may not be possible to ascertain the compensation, and the subsequent part, which makes the ascertaining of the compensation imperative in some cases. A judge would certainly struggle to avoid such a contradictory meaning in a statute if any other fairly consistent meaning could be assigned; and the section seems open to the more reasonable interpretation here attempted.

A doubt also arises as to the powers of the referees and umpire with regard to agreements under § 5. Suppose that in their opinion compensation given under such an agreement for temporary improvements is not "fair and reasonable . . . having regard to the circumstances existing at the time" it was made. Have they the power to set aside the agreement, and award compensation under the Act? It is submitted that they possess this power by necessary implication, or they could not complete their award with the particulars required under §§ 17 and 19. If the amount claimed be 100*l.* or under, their decision will be final (§ 23). If the amount claimed exceed 100*l.* (§ 23), their power is conditional, and subject to appeal, so that it will be for a legal tribunal ultimately to say, except in cases involving less than 100*l.*, whether the agreement is one to be upset or upheld. But the Act furnishes no direct appeal to the County Court except from the decision of the referees or umpire; that decision must raise any point afterwards contested; and they have not fully discharged their duties until they have made a full award in the terms of the Act upon all matters referred to them. It would seem, therefore, that great as this power is, they really may, in practice, revise and set aside all the agreements in question, and a tenant may always make it impossible to challenge their decisions, if he is content to claim no more than 100*l.*

Appeal to County Court.—One object of the legislation of 1875 was to provide cheap and easy methods of determining the rights of landlords and tenants. The new Act follows the old one, therefore, in prohibiting litigation in the High Court of Justice by an attempt to withdraw a submission or award from the jurisdiction of the referees and umpire or of the County Court by making it a rule of Court, or otherwise. The award is not to be questioned except as the Act provides (§ 22), and will conclude the whole matter if the tenant claims no more than 100*l.* If the claim exceeds 100*l.*, the award will also be final, unless, within seven days after its delivery, either party appeals to the County Court on all or any of the following grounds (§ 23):—

"1. That the award is invalid.

"2. That the award proceeds wholly or in part upon an improper application of, or upon the omission properly to apply, the special provisions of §§ 3, 4, or 5 of this Act.

"3. That compensation has been awarded for improvements, acts or things, breaches of covenants or agreements, or for committing or permitting waste, in respect of which the party claiming was not entitled to compensation.

"4. That compensation has not been awarded for improvements, acts or things, breaches of covenants or agreements, or for committing or permitting waste, in respect of which the party claiming was entitled to compensation." (§ 23.)

The Judge must hear and determine the appeal, and may remit the case to be re-heard in whole or in part by the referees or umpire. His decision on the facts will be final, but at the request of either party he is bound to state a special case on a question of law for decision by the High Court of Justice. That is the utmost limit to which the case can be carried, for the judgment of the High Court so invoked will be final, and the County Court Judge is to act thereon (§ 23). Substantially, these are the provisions in the Act of 1875, but, with a view to discourage litigation, the limit of appeal is raised from 50*l.* to 100*l.* Remembering that a claim of 100*l.* or under may now raise the question whether an agreement is to stand which was deliberately entered into by the parties, but has since been repudiated by one of them and set aside, it may be, by a single referee, this restriction on the right of appeal is a serious one. A very limited period is given for appealing, namely, seven days after delivery of the award. It would seem by reference to the earlier sections that this must mean delivery to either party. The referees or umpire should inform both parties when the award is ready for delivery, but no obligation rests on them to do so. Both parties, therefore, must be on the watch, or either may find that his right of appeal has gone. If, as under the County Court orders of 1876, an appellant must file a copy of the award within four days after its delivery, together with a concise statement in writing of his grounds of appeal, the time for appeal will be still further limited. From the grounds of appeal stated in § 23, it seems that the whole case will be heard *de novo* in the County Court, with any evidence which either party may think fit to produce for or against the claim.

As the parties may agree respecting the compensation, it will be well that such agreement should be in writing, and should set forth not only the amount but the mode and time of payment. Money so agreed, or awarded, or ordered on appeal, must be paid, with the costs, within fourteen days after the time fixed.

In case of default, payment may be enforced by obtaining an order in the County Court (§ 24), which will operate as a judgment for debt, and will enable the creditor to issue execution. Like the costs given by referees and umpire, those arising on appeal are in the discretion of the County Court, upon a scale to be fixed from time to time by the Lord Chancellor (§ 27). Upon "the application of any person interested," the County Court may appoint a guardian to represent any landlord or tenant, being an infant without a guardian, or of unsound mind, not so found by inquisition (§ 25). "Any person interested" is vague; it may be construed to include not only any person interested on behalf of the infant or insane man, but any person interested in a reference or in litigation under the Act, to which such infant or insane man should be properly a party. Since the Married Women's Property Act, 1882, came into operation (January 1, 1883), a next friend is not necessary in the case of women entitled to land who married after that date, and are affected by the Act. When a next friend is still required, as in the case of women married before January 1, and not entitled for their separate use, § 26 repeats the provisions of 1875, which vest such an appointment in the County Court. When a woman, married before January 1, 1883, desires to do "any act under this Act in respect of land," her title to which accrued before January 1, her husband's concurrence is still requisite, and the Judge of any County Court is enjoined to examine her apart from her husband, in order to see that she understands what she is about to do, and is acting freely and voluntarily. "Any act in respect of land" is again very vague. All this formality of a separate examination cannot be necessary for the purposes of notices, counter-claims, and the like; though it may be necessary for such purposes as the charge of a tenant's compensation upon the land. The new law, however, follows the old law in this phraseology.

Charge of Tenant's Compensation.

Here, again, the very important provisions of 1875, authorising the landlord to charge the holding with the amount of compensation, have served as a model for the new law, though in some respects they are varied. In 1875 the County Court had power to refuse the landlord's application. The Court now retains no discretion; the landlord has an absolute right to saddle the whole holding, or any part of it, with certain outlays incurred in improving it (§ 29). No provision appears to be made for including in the charge the cost of permanent improvements executed by the landlord. It is otherwise if these

improvements have, by his unconditional consent, or under agreement, been executed by the tenant, for then the outlay is included in the compensation, or substituted compensation, which the landlord may charge. The subjects of charge which appear to be authorised by § 29, are :—

(*a*) Permanent improvements if executed by the tenant, and included in his compensation under the Act. This charge can only be made after payment to the tenant.

(*b*) Drainage (1) when executed by the tenant, and included in his compensation, and paid for by the landlord; (2) when executed by the landlord, after notice from the tenant, under the powers in § 4, in which case the money must have been actually expended.

(*c*) Temporary improvements included in the tenant's compensation, and paid for by the landlord.

The order of charge will be in favour of the landlord, his executors, administrators, and assigns, who will receive "repayment of the amount paid or expended, with such interest, and by such instalments, and with such directions for giving effect to the charge, as the Court thinks fit."

As in 1875, a landlord must furnish the County Court with proof of the payment or expenditure; he must also satisfy it that he is acting in good faith, and that there is no collusion with the tenant for the purpose of burdening the estate with a compensation not represented by any equivalent increase in annual value. In the case of limited owners the Court may be expected to require specific evidence in order to clear up any doubts of this description, especially where compensation has been settled between the parties without calling in a referee or referees. Some protection, indeed, is afforded to persons entitled in reversion or remainder. It will be remembered that landlords must always notify the referees or umpire of an intention to charge the holding, and thereupon the award must state "the time at which, for the purposes of such charge, each improvement, act, or thing, in respect of which compensation is awarded, is to be deemed to be exhausted" (§ 19). The object of this salutary requirement is explained in § 29, which says that where a landlord is not the absolute owner, the payment of instalments and interest under any charge shall cease at the time when, according to the award, an improvement will become exhausted. If there has been no award, *i.e.* if the compensation has been agreed upon, the Court in its discretion will require evidence as to the period of exhaustion. It follows that, in the case of limited owners, an order cannot charge the holding generally with a sum the whole of which is repayable at a given period, but must create a separate charge for each improvement,

according to the date of execution, and the period of exhaustion when these periods vary. The result may be rather complicated sets of accounts in some cases.

The improvement of the land being an object of public policy, § 29 does not allow this object to be defeated by any settlement of land prohibiting the creation of any charges upon it. There is a provision, therefore, that charges under the Act shall not determine or forfeit any landlord's estate or interest, notwithstanding any deed, will, or other instrument to the contrary.

This is a new and necessary provision in conformity with the spirit of the Act. Another part of § 29 relates to limited owners, who, under the Settled Land Act, 1882, may sell portions of the settled estates, and apply the capital trust-money, among other objects, in payment for the very numerous improvements authorised by that Act (§§ 21, 25), which include drainage, irrigation, warping, drains, pipes, and machinery for supply and distribution of sewage as manure, embanking, enclosing, fencing and straightening of fences, re-division of fields, reclamation, dry warping, farm roads, clearing, trenching, planting; cottages for labourers, farm-servants, and artisans, whether employed on the settled land or not; farm-houses, offices and outbuildings, and other buildings for farming purposes; reservoirs, pipes, wells, ponds, and other works for supplying and distributing water for agricultural or other purposes. Section 29 of the Act now under consideration enables limited owners to apply this capital money in payment of any money expended, and costs incurred by them in executing under the Act any permanent improvements on drainage, or in paying off any charge on a holding created under this Act, as though it were an incumbrance which could be so discharged under the Settled Land Act.

Section 29 therefore, carrying out the policy adopted in 1875, gives increased powers to landlords who are limited owners, to charge the inheritance by a cheap and simple process, instead of being compelled to run the risk of paying out of their own pockets for improvements from which they may derive little benefit. In the case of permanent improvements, Parliament seems to have thought it expedient that they should be paid for outright by selling part of the settled estate under the Act of 1882, rather than by creating a charge under the new Agricultural Holdings Act.

Incidence of Charge.—Section 30 seems to be susceptible of two meanings. It may mean that when a landlord has the holding or an interest, such as a life interest, equivalent in law to a freehold interest, the charge on the holding may continue to affect,

not only that, but all other interests subsequent to his ; but that when the landlord has less than a freehold interest, that is, where, in a technical sense, he "is himself a tenant of the holding," the charge must not extend beyond the term for which his interest extends (§ 30). Or, in a less technical and more obvious sense, the section may merely mean that when a landlord has a farm in hand, and may thus be regarded as "himself a tenant of the holding," his power of creating a charge shall be strictly limited to his own interest. The same provision was enacted in 1875.

Trustees, or other non-beneficiary landlords, are not personally responsible for any compensation, and a tenant cannot recover from them. They can charge the holding with the amount due to the tenant either before or after paying him. In the event of their neglect or failure to pay, he can, one month after quitting the holding, go to the County Court, and, "on proof of his title to have a charge made in his favour," obtain a charge on the holding, for himself, his executors, administrators, and assigns, for this amount, together with "all costs properly incurred by him in obtaining the charge, or in raising the amount due thereunder" (§ 31). If an appeal is pending, the tenant would of course be unable to prove his title. It appears to be contemplated that tenants will generally raise the amount due, assigning the charge for purposes of repayment. Indeed, § 32 gives facilities with this object both to landlords and tenants, as in the Act of 1875, by allowing any company empowered to advance money for the improvement of land, to take an assignment of any charge made under the Act, upon such terms and conditions as may be agreed, and afterwards to assign it "to any person or persons whomsoever." The intervention of the land improvement companies may be convenient and useful in many cases ; but the statutory security afforded by these charges ought to make them easily marketable.

Notice to Quit.

Time of Notice to Quit (§ 33).—This section, applicable to tenancies from year to year, aims at the same object as was contemplated by the corresponding provision in 1875. Instead of a half-year's notice expiring with a year of tenancy, it substitutes a year's notice, unless the landlord and tenant agree in writing that § 33 shall not apply, in which case a half-year's notice will continue to be sufficient. In the case of tenants who are adjudged bankrupt, or who file petitions for composition or arrangement with creditors, § 33 does not apply, and the trustee in bankruptcy may at once disclaim. In the Act of 1875 either party

to an existing contract of tenancy could exclude the section requiring this extended notice to quit by notice to the other, or by agreement without notice.* Now a year's notice must be given, unless both landlord and tenant agree in writing that six months' notice shall suffice. Another important change is that § 33 affects tenancies from year to year, whether they began before or after January 1, 1884. The result is that, unless notice was given before the new year in the case of then existing tenancies, or unless there has since been an agreement to exclude the section, a year's notice must now be given on either side expiring with the year of tenancy. Leases are not affected.

"Contracts of tenancy current at the commencement of this Act," that is, at January 1, 1884, is a term used, it will be remembered, in § 5. Such tenancies are also affected by § 33. According to § 61 we are, for the purposes of the Act, to interpret a tenancy from year to year under such contracts as continuing until the first day on which the landlord or tenant could, by giving notice to the other, cause the tenancy to determine; on and after that day it is to be deemed a tenancy under a contract of tenancy beginning after the commencement of the Act. We must join together § 33 and § 61 to see when yearly tenancies current on January 1 can be determined, and when therefore the Act will take full effect upon such tenancies. All contracts of tenancy from year to year existing on January 1 being put an end to, as far as notice to quit is concerned, unless expressly renewed by agreement, it follows that all such contracts not so renewed can only be determined by a year's notice expiring with a year of tenancy. A Lady-Day holding, then, it would seem, might be determined by a year's notice given at Lady-Day, 1884, and expiring at the same period in 1885; a Michaelmas holding by a notice given at Michaelmas, 1884, and expiring at Michaelmas, 1885; the last of the existing tenancies to be determined being those which begin to run at Christmas, and as to which, if no notice were given at Christmas, 1883, the earliest notice after the commencement of the Act would be one beginning at Christmas, 1884, and ending at the same time in 1885. According to this view, the Act will take full effect upon all existing tenancies from year to year in January, 1886; land let upon lease will of course be affected only at the end of the respective terms limited in the lease.

Another view, however, entitled to respect is taken by Mr. Shaw-Lefevre,† namely, that as regards tenancies current at January 1, 1884, the Act will not come into full operation until

* See a case under the Agricultural Holdings Act, 1875, decided by Lord Coleridge in 1878 (Wilkinson *v.* Calvert, 3 L. R., C. P. D., 360).

† 'Nineteenth Century' for October, 1883, p. 685.

a year later; that is, in the case of Michaelmas holdings terminable (by agreement under § 33) by six months' notice, the Act will not have full effect until after Michaelmas, 1885; and if terminable by a year's notice, until after Michaelmas, 1886. This view seems to be based upon the assumption that each tenancy existing at January 1, 1884, and unaffected by previous notice to quit, is a new tenancy for purposes of notice, giving an absolute term for one year, so that no notice can take effect during that year. In the case already cited, however, Lord Coleridge doubted whether the true view of the Act of 1875 was that under it current tenancies became new tenancies for purposes of notice.* It may be well here to bear in mind that there is a distinction between a six months' notice—*i.e.*, six lunar months—and a half-year's notice. The Act provides for a half-year's or year's notice, as the case may be; and "a six months' notice to determine a yearly tenancy commencing on one of the ordinary feast days (as Lady-Day or Michaelmas) means a 'customary six months,' that is, from one of the usual quarter days to the quarter day next but one following, though such six months should exceed or fall short of the number of days which constitute half a year. Consequently, a notice served on the 26th of March to quit on the 29th of September then next, is not a valid notice." †

Fixtures.

Tenant's Property in Fixtures, Machinery, &c. (§ 34).—Before the Act of 1875, tenants who, with the consent of their landlords, had put up at their own expense farm or other buildings, and engines or machinery for agricultural purposes, or for mixed purposes of trade and agriculture, were allowed to remove these fixtures, if they had not been erected or put up in pursuance of some obligation by the tenant; but the landlord had an option of purchase, the price being settled by two referees or an umpire. If the landlord did not exercise his option, the tenant was bound, in removing these fixtures, not to damage the premises, which were to be put "in like or as good plight and condition as the same were in before the erection of the things so removed." ‡

The Act of 1875 altered the law in favour of tenants by giving them the same property in engines, machinery, or other fixtures affixed to the holding, notwithstanding the absence of the landlord's consent; in spite, indeed, of his dissent, unless there was

* 3 L. R., C. P. D., p. 364. † Morgan v. Davies, 3 L. R., C. P. D., p. 260.
‡ 14 & 15 Vict. c. 25.

an agreement to the contrary. The Act of 1883 adopts the corresponding section of the earlier statute with a few alterations. It extends the tenant's rights to fencing, and (what is much more important) to any building for which, as well as for the engines, machinery, fencing, or other fixtures, "he is not under this Act or otherwise entitled to compensation." The effect of this provision will be that, if the landlord (under § 3) refuses his consent to the erection of buildings, or the making of fences (permanent improvements 1 and 9), the tenant may still erect them, and, not being entitled to recover compensation for them under the Act, will be able to remove them at the determination of the tenancy, subject to the conditions specified, which include the landlord's right of purchase. Another change is made in the law. A proviso to § 53 in the Act of 1875 excepted a steam-engine from the tenant's right to remove fixtures, unless the tenant had given written notice of his intention to erect it, and the landlord had not objected. Section 34 in the new Act does not make this exception. It may be taken, therefore, that "engine" in the section would cover the tenant's property in steam-engines affixed to the holding. Section 34 also provides that a tenant may remove the fixtures or buildings "before or within a reasonable time after the termination of the tenancy."

In other respects § 34 follows exactly the wording of § 53 enacted in 1875. The conditions imposed upon the right thus given to the tenant are that (1) before removing any fixture or building he shall pay all rent owing by him, and perform or satisfy all his other obligations in respect of the holding; (2) in removing the fixture or building, he shall not do any avoidable damage to any other building or any other part of the holding; (3) immediately after the removal he shall make good all damage occasioned to any other building or other part of the holding by the removal; (4) he shall not remove any fixture or building without giving his landlord one month's previous notice in writing; (5) at any time before the expiration of this notice the landlord may elect to purchase any such fixture or building, the price being "the fair value thereof to an incoming tenant," and being settled, in case of difference, by a reference under the Act, as in cases of compensation, but without the right of appeal. In other words, all awards will be final upon this class of cases.

Crown and Duchy Lands.

The three sections 35–37 are a re-enactment, with few variations, of corresponding sections in the Act of 1875. They specifically bind the Crown in respect of Crown lands and

lands belonging to the two Duchies of Lancaster and Cornwall. The "landlord" for the purposes of the Act will be (1) for Crown land, the Commissioners of Woods, Forests, and Land Revenues, or one of them, or some person appointed under the royal sign manual; (2) for Duchy of Lancaster land, the Chancellor of the Duchy; (3) for Duchy of Cornwall land, such person as may be from time to time appointed by the Duke of Cornwall for the time being, or by the personage for the time being entitled to the revenues and possessions of the Duchy. These substituted landlords will give and receive notices under the Act; and the machinery provided in the Act will apply to all differences arising with the tenants on these lands. Special provision, however, is made, as follows, for the charge of a tenant's compensation.

In the case of Crown lands, the compensation payable for permanent improvements and drainage, instead of being charged on the holding, will be charged under the Crown Lands Act, 1866, § 1, "as a principal sum to the account of the capital of the land revenue of the Crown," the sum so charged being "repaid out of the income of the land revenue of the Crown," as the Treasury may direct. Compensation for temporary improvements will be deemed to be part of the expenses of management (§ 35). As to Duchy of Lancaster lands, permanent improvements and drainage will be deemed an improvement of land within 57 Geo. 3, c. 97, s. 25, which authorises the Chancellor and his Council to sell so much of the funded property of the Duchy as may be necessary to repay the cost of such improvement. Compensation to tenants for temporary improvements will be paid out of the annual revenues of the Duchy (§ 36). As to the Duchy of Cornwall estates, the compensation for permanent improvements and drainage will be advanced from the Duchy funds arising from sales and enfranchisements, and will be charged upon the Duchy revenue, with a provision for repayment by annual instalments in not less than thirty years (§ 37; and see Duchy of Cornwall Management Act, 1863, s. 8). As § 37 makes no special provision for the payment of compensation for temporary improvements, it may be assumed that the substituted landlord may either obtain a charge in respect of them from the County Court in the ordinary course, or defray them out of revenue.

Ecclesiastical and Charity Lands.

The provisions made in 1875–6 with respect to these lands are also now re-enacted. An archbishop or bishop is the landlord where lands form the endowment of a see, but he must

exercise no powers under the Act in respect of these lands except with the previous approval in writing of the Estates Committee of the Ecclesiastical Commissioners (§ 81). In like manner, where the glebe land or other land belonging to the benefice is let, the incumbent as landlord, before exercising the powers of the Act, must have the approval of the patron entitled to present upon a vacancy, or of the Governors of Queen Anne's Bounty, who may, if they think fit, on behalf of the incumbent, pay to the tenant the amount of compensation due to him, and may thereupon obtain a charge upon the holding in their favour. This charge will be effectual, notwithstanding any change of the incumbent (§ 39). The incumbent may, it seems, with the approval of the Governors of Queen Anne's Bounty, obtain a charge on the holding. In fact, as there is no obligation upon them to advance the money, he must do so on their default; but it is obviously better that this duty should be performed by the Governors. The Act of 1875 required them to communicate with the patron in exercising any of these powers. They are now relieved from this necessity.

Trustees in whom the legal estate of lands is vested for ecclesiastical or charitable purposes are, as in 1875, prohibited from charging the land for compensation due to tenants, except with the written approval of the Charity Commissioners (§ 40).

Resumption for Improvements.

Another very useful provision in the Act of 1875, now incorporated in the new Act, is that authorising landlords to give a tenant from year to year notice to quit part of his holding, in order that they may resume possession of such part for any of the eight following purposes (§ 41):—

1. Erecting farm labourers' cottages, with or without gardens.
2. Providing gardens for existing farm labourers' cottages or other houses.
3. Allotment for labourers of land for gardens or other purposes.
4. Planting trees.
5. Opening or working any coal, ironstone, limestone, or other mineral; or a stone quarry, clay, sand, or gravel pit; or constructing any works or buildings to be used in connection therewith.
6. Obtaining brick-earth, gravel, or sand.
7. Making a water-course or reservoir.
8. Making any road, railway, tram-road, siding, canal, or basin, or any wharf, pier, or other work connected therewith.

The only change made in adopting the corresponding provision (§ 52) of 1875 is the addition of "railway" to the improvements specified in No. 8. The power reserved to landlords by § 41 derives new importance from the powers conferred on limited owners by the Settled Land Act, 1882, already mentioned, a most useful and beneficial measure in connection with which the name of Lord Cairns will always be gratefully remembered. Limited owners are now able to sell any part of the settled estates, except the mansion and park, even without the sanction of the trustees, for the purposes of improvements authorised by that Act. As capital may thus be easily raised by a tenant for life for developing the settled estate, without trenching upon his personalty, it is probable that necessary, and even to some extent speculative, improvements will become much more usual upon land tied up in settlement. The authorised improvements in Lord Cairns's Act include most of those specified in § 41, so that the one statute will help the other, and capital will be forthcoming in order to carry out the various objects for which a landlord may resume possession of parts of a holding without otherwise disturbing the tenancy.

A tenant's interest on the landlord's resumption is amply secured. On receiving notice under § 41 he is entitled to (*a*) compensation in respect of improvements made on the land which is the subject of notice; (*b*) a reduction of rent in respect of such land, measured not by its acreage alone, but also by any depreciation in value which the rest of the holding may suffer by reason of the landlord's resumption, or the use to be made of the land so resumed; or (*c*) at any time within twenty-eight days after receiving notice to quit a part, he may in writing tell his landlord that he accepts it as notice to quit the entire holding, and such notice will take effect at the expiration of the then current year of tenancy.

It may be assumed that any notice given by the landlord under § 41 will be subject to the same conditions as are imposed by § 33 as to time in any general notice to quit, and that therefore a year's notice must be given, expiring with the year of tenancy, unless both landlord and tenant have agreed upon six months. The compensation, if any, together with the reduction in rent and depreciation in value, if any, of the rest of the holding, will be settled, in case of difference, by a reference under the Act, but with no power of appeal from the decision of referees or umpire.

Provision as to Limited Owners (§ 42).—Lest the powers of limited owners under this Act should suffer undue restraint so far as concerns the improvement of the land and tenants' compensation, it is provided that, subject to the special arrange-

ments made in §§ 35–40 for improvements on Crown, duchy, ecclesiastical and charity lands, "a landlord, whatever may be his estate or interest in his holding, may give any consent, make any agreement, or do or have done to him any act in relation to improvements in respect of which compensation is payable under this Act," as though he were owner in fee if his estate is one of inheritance, or if he be a lessee, as though he were possessed of the whole estate in the leasehold. A landlord who is tenant for life, therefore, may, for all purposes of this Act, be regarded as owner in fee. In the case of a leasehold, any person for the time being "entitled to receive the rents and profits of any holding" which is the subject of the lease may act and be treated as though he had the whole estate under the lease; and his powers will extend over the whole term of the lease, and will not be limited by his interest in the lease.

Provision in case of Reservation of Rent (§ 43).—Life tenants, not excepting corporations sole and aggregate, have frequently abused their powers by leasing settled property at low rents, in consideration of fines or lump sums applied for their own benefit, at the expense of the persons entitled in reversion or remainder. To guard against this abuse, it is generally provided in statutes, or in the deed of settlement, that leases should only be made at the best rent, or reservation in the nature of rent, which can be obtained. It would be necessary, in strict compliance with such provisions, that sitting tenants, on the expiration and renewal of their leases, should have their rents raised upon the improved value due to their own improvements. In order to protect sitting tenants against rack-rentals imposed under this obligation, which is often considered imperative by trustees and others, § 43 relieves landlords from any obligation so imposed, whether by statute, deed, or other instrument. Henceforth they need not "take into account against the tenant the increase (if any) in the value of his holding arising from any improvements made or paid for by him on such holding." They are not, however, prohibited from doing so; the section only says "it shall not be necessary" for them to do so; in other words, they are left to make an equitable arrangement in view of the circumstances of each case.

Distress.

In 1882 a Committee of the House of Commons was appointed to consider the law of distress. The Chairman was Mr. Goschen, and the Report and Minutes of Evidence contain a body of valuable information as to the origin of the law, the successive changes made in it, and its practical working. The first statute

regulating it was passed in the year 1267, but distress had existed long before. It was the method employed under the feudal system for compelling tenants to pay the rent or perform the services agreed upon. The statutes passed seem to have been chiefly designed to mitigate its rigour under the common law, as, *e.g.*, that distresses should be reasonable;* that things taken in distress should not be removed from the county; that cattle distrained should not be driven out of the hundred, &c.:† that no man should be distrained for more service in respect of any freehold than was due.‡ The lord's remedy was limited to the seizure of goods which were held as pledges until payment made or service rendered, and could then be returned to the tenant without deterioration. In 1689 this remedy was extended to sheaves of corn and hay, which at common law could not be distrained, but were then allowed to be so taken for rent.§ In 1737 live-stock, grass, hops, and other produce were included among the subjects of distraint.‖ The origin of a modern rule may be found in a statute of the year 1300, that distress should not be made on beasts of the plough, nor on sheep, so long as there was any other subject of distress.¶

The abolition in 1880 of the law of hypothec in Scotland added to the strength of the feeling that some modification should be made in the English law, limiting the six years' rent for which a landlord could distrain, and also his power over agisted cattle and hired machinery. In Scotland, however, as the Lord Advocate informed the Committee, a landlord still enjoys special protection, notwithstanding the legislation of 1880, for, when six months' rent remains unpaid, he may sue for it before the Judge Ordinary and obtain a decree of removal against the tenant, unless the tenant finds security not only for the rent due but for the rent of the next five years. Under the law of hypothec, too, a landlord in Scotland might prevent his tenants from disposing of their crops before the rent became due, a power never possessed by landlords in England.

From the evidence taken by the Committee it appeared that, on the whole, farm-tenants did not favour the total abolition of a landlord's right to distrain, but thought it should be retained with modifications, on grounds set forth in the Report, the most important of which may be thus summarised:—

1. That if it were abolished, some law or conditions in the creation of tenancies more objectionable, and possibly injurious, would of necessity be introduced, such as rent paid in advance;

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* 52 Henry 3, c. 4.

† 1 Philip and Mary, c. 12, s. 1.

‡ 25 Edward 1 (*Magna Carta*), c. 10.

§ 2 William and Mary, c. 5, s. 3.

‖ 11 Geo. 2, c. 19, ss. 8, 9.

¶ 28 Edward 1, c. 12.

finding security; bills of sale; stringent power of immediate re-entry.

2. That it is a cheap and easy remedy, rarely enforced by landlords, but one properly belonging to them, as the credit they give to a tenant cannot be stopped at pleasure, and their claims are thus of necessity always accruing. Moreover, in case of a tenant's insolvency, landlords would, without a preferential right over any other creditor, be in a worse position than any other creditor, since they might not only lose their rent, but be compelled to resume possession of their land seriously depreciated in letting value by bad cultivation.

3. That the operation of a law of distress is favourable to small tenants, who may thereby obtain credit from their landlords, equivalent to a considerable advance of money without interest. Thus an opening is given to rising men of skill and industry, but of small capital; such men on the poorer kinds of soil often proving the best cultivators.

On the other hand, the arguments urged against the law were—

1. That its existence "leads to undue competition for farms, and induces owners (especially needy ones) to accept as eligible tenants persons with insufficient means, one effect being to raise the rent to solvent men; and that the repeal of the law would prove an additional incentive to landowners to secure first-class tenants."

2. That it "impairs the general credit of tenant-farmers" by giving the landlord "an unfair preference over other creditors," whereas "there is no difference in the commercial position of the landlord who supplies the land and the man who supplies any other commodity."

3. "That it encourages bad farming, and leads to diminished production." *

The recommendations of the Committee, made in July, 1882, have been closely followed in the Act now under consideration, and no better testimony could be borne to the value of their inquiry and the precision with which they set forth the necessary changes in the law. Their first suggestion was that the law of distress should be modified, not abolished, and that the right of distraint should be restricted to one year's rent, this right only to be exercised within six months after the year's rent had become due.

* Report of Select Committee on the Law of Distress, 1882, pp. 4, 5. It is right to mention that the report was drafted by Mr. Salt. The other members of the Committee were Mr. Goschen, Mr. Heneage, Sir Massey Lopes, Mr. Cropper, Sir William Hart Dyke, Mr. Blennerhassett, Colonel Brise, Mr. Duckham, Mr. Biddell, Sir Joseph Pease, Mr. Fellows, Mr. James Howard, Mr. Akers-Douglas, Dr. Commins, Sir Gabriel Goldney, Mr. Rendel.

Limitation of Distress in respect of Amount and Time.—Accordingly, § 44 prohibits any landlord after January 1, 1884, from distraining under § 54, on any holding to which the Act applies, for rent due more than one year before the distress is made. There is an exception in the case of back rents due on holdings which were let on January 1, 1884; arrears of rent will be recoverable by distress on these holdings up to January 1, 1885, to the same extent as if this Act had not passed. Another exception applies to the numerous cases in which landlords allow their tenants to defer payment of rent for a quarter or half-year after it is properly due. Clearly, landlords ought not to suffer by continuing this privilege, and, on the other hand, tenants would think it hard to be deprived of this privilege by a law passed in their interests. This quarter or half-year of grace will not, therefore, count in limiting the landlord's right of distraint; the year's rent, for purposes of distraint, will be deemed to have become due at the expiration of such quarter or half-year, and not at the date at which it legally became due.

Current tenancies, it will be seen, come under the operation of § 44, before the Act, as a whole, takes full effect with respect to them. The section also applies to leases as well as tenancies from year to year. Landlords have the present year in which to recover arrears of rent by distress upon tenancies current on January 1, 1884. Afterwards, in all cases, their preferential right over other creditors will be limited to a year's rent, for which, save in the excepted cases, they must distrain within the year. For arrears beyond the one year's rent, they will rank with other creditors, and must recover by ordinary course of law.

Limitation of Distress in respect of Things to be distrained (§ 45).—Certain incidents in the law of distress, allowing the seizure of agisted stock, have long been felt to be harsh and unreasonable; and there have been cases in which this right has been rigidly exercised by landlords. Not only did the right to distrain extend to cattle taken by the tenant on tack; it included, under certain circumstances, a stranger's cattle trespassing upon the holding by their owner's negligence, or (according to an old decision) cattle straying there through insufficient fences on the holding, if they had continued there for a night and a day, with notice meanwhile to the owner.* Many attempts have been made to alter the law, with a view to exempt agisted stock from distress, and in 1881 Mr. Chaplin introduced a Bill with this object, which passed through Committee, but did not become law.

* Poole *v.* Longueville, 2 Saunders, 289.

In principle something was to be said for the landlord's right. Cattle, sheep, or horses, taken by a tenant on tack, deprive the landlord of his security for rent in proportion to their consumption of the growing crops; and for this reason some farm agreements prohibit agistment without his consent. The landlord has therefore a right to demand, in respect of agisted stock, such a sum as fairly represents the value of the crops so consumed; and the best measure of this value is the sum agreed to be paid for the agistment, if it is a *bonâ-fide* payment, not arranged with a view to cut down or defeat the landlord's claim. Beyond the recovery of this sum, the landlord's right over agisted stock is, to say the least, unreasonable.

Such, indeed, was the limit imposed upon the landlord's right in Scotland more than fifteen years ago. The Hypothec Amendment Act of 1867 * provided that, if a farm-tenant or lessee took any sheep, cattle, or other live-stock, to be grazed or fed, for a *bonâ fide* payment equal to the just value of such grazing or feeding, the landlord's hypothec in respect of them should extend only to the amount thus paid, and no further; and in case of their removal the right of hypothec only extended to the amount unpaid. The Committee of 1882, therefore, had an authoritative precedent in recommending, as they did, with regard to agisted stock, that "the limit of distress should be the consideration payable for the grazing to the farmer who takes in the stock." But they went further, in also recommending "that provision be made for the protection of machinery not the property of the tenant; also that animals, not the property of the tenant, temporarily upon the holding for breeding purposes, be exempt."

Section 45 exactly embodies these suggestions. It provides that if a tenant takes "live stock" to be fed "at a fair price," such stock shall not be distrained at all when other sufficient subjects of distress can be found; and, if so distrained, the landlord can only recover in respect of such stock the sum agreed to be paid for agistment, or any unpaid portion of it. "Live stock" is defined to mean "any animal capable of being distrained" † (§ 61). At any time before sale, the owner of the stock may redeem it by paying the sum due for agistment, and this payment frees the owner from any like claim by the tenant. So long as any portion of the agisted stock remains on the holding, the right to distrain continues, to the full extent of the sum agreed to be paid for the feeding of the whole of the stock,

* 30 & 31 Vict. c. 42, s. 5.

† Animals *feræ naturæ* are not within this category, though it has been held that the exception does not apply if they are kept in a private enclosure for purposes of trade or profit, and deer so enclosed have been distrained.

or, in case of a *bonâ fide* payment in part, then to the full extent of the balance. It would seem that the landlord's right under § 45 might be defeated if the owner of the stock paid to the tenant in advance, in good faith, the whole sum agreed.

In accordance with the recommendations of the Committee, § 45 also exempts from distraint (*a*) agricultural or other machinery hired by a tenant under a *bonâ fide* agreement for its use in the conduct of his business; and (*b*) live stock of all kinds belonging to strangers, and on the tenant's premises for breeding purposes.

Remedy for Wrongful Distress under the Act (§ 46).—As for recovery of compensation, so for the settlement of disputes as to distress, the object of the statute is to provide the simplest and cheapest process. It has been already stated that landlords seldom resort to distress; but the new limitation as to time may make it necessary for them to do so more frequently. Disputes will therefore be more frequent concerning alleged wrongful levies; the ownership of stock, agisted or belonging to the tenant; whether the price agreed to be paid for the grazing is "a fair price." These and other differences relating to distress may be tried and disposed of in the County Court, or before the magistrates in Petty Sessions, either of which tribunals may order the restoration of any live stock or things unlawfully distrained, or may decide as to the price of the grazing where this is to be ascertained, "or may make any other order which justice requires." Proceedings in either Court will no doubt be initiated upon summons taken out by the aggrieved person. An appeal will lie from any decision to a Court of Quarter Sessions. The appellant, however, must "give such security to the other party as the Court may think just," a necessary provision, as otherwise a tenant might appeal for the mere purpose of delaying or escaping payment. In order to prevent any litigious person from swelling the costs of litigation, § 48 prohibits the removal of proceedings relating to distress from the County Court or Petty Sessions into the High Court of Justice.

Set-off of Compensation against Rent (§ 47).—Another proper and beneficial change in the law in the tenant's interest is made by this section agreeably to the recommendation of the Committee of 1882. "The law of distress," as they reported, "enables the landlord to distrain for the full amount of rent due, without allowing for any counter-claim which the tenant may have secured to him under agreement against his landlord; and some cases of great hardship have been given in evidence where tenants have had to resort to action at law for the recovery of their claims. Provision should be made to meet this difficulty." Accordingly § 47 puts an end to this one-sided state of the

law by providing that upon distraint a tenant may set off against the rent any compensation then ascertained to be due under the Act or under any custom or contract ; and the landlord can only distrain for the balance.

Limitation of Costs in case of Distress (§ 49).—An Act passed in 1817 * regulates the costs and charges in cases of distress for sums not exceeding 20*l.* The Committee of 1882 recommended that the same scale should apply to distress for rent up to 50*l.* ; and they called attention to the "heavy and unnecessary costs incident to the processes of distress and the sale of effects." Section 49 goes even further than the suggestion here made, for, leaving the existing statutory scale in force as to distress levied generally for sums not exceeding 20*l.*, it enacts the following scale of costs and charges, which are to regulate all distraints for rent above 20*l.* on holdings to which the Act applies:—

"1. Levying distress. Three per cent. on any sum exceeding 20*l.* and not exceeding 50*l.* Two and a half per cent. on any sum exceeding 50*l.*

"2. To bailiff for levy, 1*l.* 1*s.*

"3. To men in possession, if boarded, 3*s.* 6*d.* per day ; if not boarded, 5*s.* per day.

"4. For advertisements, the sum actually paid.

"5. To auctioneer. For sale 5*l.* per cent. on the sum realised, not exceeding 100*l.*, and 4*l.* per cent. on any additional sum realised, not exceeding 100*l.* ; and on any sum exceeding 200*l.*, 3*l.* per cent. A fraction of 1*l.* to be in all cases considered 1*l.*

"6. Reasonable costs and charges where distress is withdrawn, or where no sale takes place, and for negotiations between landlord and tenant respecting the distress ; such costs and charges, in case the parties differ, to be taxed by the Registrar of the County Court of the district in which the distress is made."

The power of taxation given to the County Court Registrar carries out another useful suggestion made by the Committee of 1882.

Appraisement and Sale at Public Auction (§ 50).—An Act passed in the year 1689 † required that, before the sale of goods distrained, they should be appraised by two persons sworn by the Sheriff to appraise truly. By general consent among the witnesses examined in 1882 this process was condemned. Auctioneers were entitled to 2½ per cent. for appraisement, but it was of no practical value, except in very rare cases where

* 57 Geo. 3, c. 93.

† 2 Will. and Mary, c. 5, s. 1.

tenants wished to take to the goods at a valuation; as a rule, appraisement was "only useful to hang a charge upon." * It was also said to involve considerable abuse and extortion, and the landlord was liable to the tenant in such cases.† The Committee therefore recommended that appraisement previous to sale should be omitted; and, with a view to some supervision over this class of officials, they were of opinion "that bailiffs should be approved by the County Court Judge of the district in which they act, and be subject to removal by him for extortion or misconduct."

Agreeably to these suggestions, § 50 repeals the Act of 1689 as to the appraisement of goods distrained before sale, and further provides, with a view to secure better prices, that the goods may be removed to a public auction-room, or other fit and proper place, and sold there. This was another recommendation of the Select Committee. If the tenant wishes the goods to be removed, he must make a written request to this effect, and pay the expenses of removal, and of any damage done in removing the goods.

Bailiffs to be appointed by the County Court.—The second portion of the Committee's recommendation just given is carried into effect by § 52, which provides that after January 1, 1884, all bailiffs entitled to levy distress on any holdings to which the Act applies must be appointed in writing by the County Court Judges, who are required to choose a competent number of fit and proper persons to act in this capacity; and these bailiffs may be summarily dismissed, if proved guilty of extortion or other misconduct in the execution of their duty. There is good reason why this class of persons, in town as well as in country, should be held responsible for abuse of their authority; but § 52 deals only with holdings under the Act.

Extension of Time to Replevy at Request of Tenant (§ 51).—The Act of 1689, already quoted, allowed a tenant five days for replevying. The Select Committee were of opinion that the time during which a bailiff might remain in possession should be extended to fifteen days, and that no sale should take place sooner if the tenant desired this delay. Section 51 accordingly provides that, in holdings to which the Act applies, tenants may replevy goods and chattels distrained during this extended time of fifteen days, but they must make a written request to the landlord, or other person levying the distress, and also give security for any additional costs incurred through any delay of the sale. If both parties concur, the goods and chattels dis-

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* Report of Committee on Law of Distress; evidence of Mr. E. L. Cave, solicitor, pp. 191, 193.

† *Ib.*, evidence of Sir Henry James, p. 196.

trained may be sold, in whole or in part, before the fifteen days expire. This can only be done, however, with the tenant's written consent.

It is seldom that a Committee's report proves so fruitful in legislation; both landlords and tenants have reason to be grateful to the Select Committee of 1882 for the thoroughness of their inquiry, and the practical recommendations which have modified what was in some respects a harsh law, and brought it into harmony with public opinion without any sacrifice of principle. Whether tenants will benefit on the whole by diminishing the landlord's security for his rent is a question which experience alone will settle. Other parts of the Act suggest the same problem. That it will make tenants more independent, and place their relations with landlords on a more strictly commercial basis than heretofore, is a result which was certainly inevitable, and may perhaps in the long run prove beneficial in promoting the cultivation of the soil. It must make landlords even more careful than they now are in letting their farms, for the Act gives opportunities of which unscrupulous tenants may avail themselves to give much trouble, and put landlords to much expense in resisting unfounded claims. Fortunately, neither tenants nor landlords as a class come within this category; there is in both a fund of right feeling, of good sense, and mutual forbearance, which may be reckoned on with confidence in the new relations which the Act of 1883 will develop.

Though in principle it is hard to justify retrospective legislation in favour of a class, and though in this respect and in its interference with the law of contract the Act may set, I fear, a bad example and precedent, still its practical results will not be formidable in either direction. Some time must pass before the new difficulties in valuing tenant-right are overcome, and a fair basis of value established, though these difficulties have been exaggerated. Doubtful points in the statute will also have to be construed, and its practical working cannot all at once be understood. Meanwhile its immediate effect must be to promote agreements which fairly carry out the spirit of the Act. It is impossible, of course, to predict what the ingenuity of draftsmen may by-and-by accomplish in evading obligations which Parliament has sought to impose. I do not agree with the commentators who think they have already discovered the necessary loopholes in the Act, and that it will not be hard for landowners to contract themselves out of it. I am sure, too, that this will not be the spirit by which landlords will generally be guided in acting under its provisions. Agreements adapted to the special circumstances of various estates and holdings

there will inevitably be; but these agreements will, as a rule, embody the "fair and reasonable" compensation mentioned in the statute. In the long run it cannot be the interest of either landlords or tenants to invite litigation by trying, on the one hand, to escape from paying the fair compensation contemplated by Parliament, or, on the other hand, by making unreasonable claims in order to pile up compensation. Allowing for exceptional cases, which occur now and must be expected hereafter, we may fairly trust to the self-interest of the two parties, to say nothing of the old confidence which for so many ages has governed the relations of English landlords and tenants, to make the Agricultural Holdings Act, 1883, in practice a useful and beneficial measure. That it is meanwhile "an honest attempt to settle a difficult question" is a judgment pronounced in its favour by a thoroughly competent as well as impartial witness.*

AGRICULTURAL HOLDINGS (ENGLAND) ACT, 1883.

[46 & 47 Vict. Ch. 61.]

ARRANGEMENT OF SECTIONS.

PART I.

Improvements.

Compensation for Improvements.

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* The Duke of Richmond and Gordon, in his speech at Chichester already cited.

PART III.

General Provisions.

CHAPTER 61.

An Act for amending the Law relating to Agricultural Holdings in England.
[25th August 1883.]

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:

PART I.

Improvements.

Compensation for Improvements.

1. *General right of tenant to compensation.*—Subject as in this Act mentioned, where a tenant has made on his holding any improvement comprised in the First Schedule hereto, he shall, on and after the commencement of this Act, be entitled on quitting his holding at the determination of a tenancy to obtain from the landlord as compensation under this Act for such improvement such sum as fairly represents the value of the improvement to an incoming tenant: Provided always, that in estimating the value of any improvement in the First Schedule hereto there shall not be taken into account as part of the improvement made by the tenant what is justly due to the inherent capabilities of the soil.

As to Improvements executed before the Commencement of Act.

2. *Restrictions as to improvements before Act.*—Compensation under this Act shall not be payable in respect of improvements executed before the commencement of this Act, with the exceptions following, that—

(i.) Where a tenant has within ten years before the commencement of this Act made an improvement mentioned in the third part of the First Schedule hereto, and he is not entitled under any contract, or custom, or

under the Agricultural Holdings (England) Act, 1875, to compensation in respect of such improvement; or

(2.) Where a tenant has executed an improvement mentioned in the first or second part of the said First Schedule within ten years previous to the commencement of this Act, and he is not entitled under any contract, or custom, or under the Agricultural Holdings (England) Act, 1875, to compensation in respect of such improvement, and the landlord within one year after the commencement of this Act declares in writing his consent to the making of such improvement, then such tenant on quitting his holding at the determination of a tenancy after the commencement of this Act may claim compensation under this Act in respect of such improvement in the same manner as if this Act had been in force at the time of the execution of such improvement.

As to Improvements executed after the Commencement of Act.

3. *Consent of landlord as to improvement in First Schedule, Part I.*—Compensation under this Act shall not be payable in respect of any improvement mentioned in the first part of the First Schedule hereto, and executed after the commencement of this Act, unless the landlord, or his agent duly authorised in that behalf, has, previously to the execution of the improvement and after the passing of this Act, consented in writing to the making of such improvement, and any such consent may be given by the landlord unconditionally, or upon such terms as to compensation, or otherwise, as may be agreed upon between the landlord and the tenant, and in the event of any agreement being made between the landlord and the tenant, any compensation payable thereunder shall be deemed to be substituted for compensation under this Act.

4. *Notice to landlord as to improvement in First Schedule, Part II.*—Compensation under this Act shall not be payable in respect of any improvement mentioned in the second part of the First Schedule hereto, and executed after the commencement of this Act, unless the tenant has, not more than three months and not less than two months before beginning to execute such improvement, given to the landlord, or his agent duly authorised in that behalf, notice in writing of his intention so to do, and of the manner in which he proposes to do the intended work, and upon such notice being given, the landlord and tenant may agree on the terms as to compensation or otherwise on which the improvement is to be executed, and in the event of any such agreement being made, any compensation payable thereunder shall be deemed to be substituted for compensation under this Act, or the landlord may, unless the notice of the tenant is previously withdrawn, undertake to execute the improvement himself, and may execute the same in any reasonable and proper manner which he thinks fit, and charge the tenant with a sum not exceeding five pounds per centum per annum on the outlay incurred in executing the improvement, or not exceeding such annual sum payable for a period of twenty-five years as will repay such outlay in the said period, with interest at the rate of three per centum per annum, such annual sum to be recoverable as rent. In default of any such agreement or undertaking, and also in the event of the landlord failing to comply with his undertaking within a reasonable time, the tenant may execute the improvement himself, and shall in respect thereof be entitled to compensation under this Act.

The landlord and tenant may, if they think fit, dispense with any notice under this section, and come to an agreement in a lease or otherwise between themselves in the same manner and of the same validity as if such notice had been given.

5. *Reservation as to existing and future contracts of tenancy.*—Where, in the case of a tenancy under a contract of tenancy current at the com-

mencement of this Act, any agreement in writing or custom, or the Agricultural Holdings (England) Act, 1875, provides specific compensation for any improvement comprised in the First Schedule hereto, compensation in respect of such improvement, although executed after the commencement of this Act, shall be payable in pursuance of such agreement, custom, or Act of Parliament, and shall be deemed to be substituted for compensation under this Act.

Where in the case of a tenancy under a contract of tenancy beginning after the commencement of this Act, any particular agreement in writing secures to the tenant for any improvement mentioned in the third part of the First Schedule hereto, and executed after the commencement of this Act, fair and reasonable compensation, having regard to the circumstances existing at the time of making such agreement, then in such case the compensation in respect of such improvement shall be payable in pursuance of the particular agreement, and shall be deemed to be substituted for compensation under this Act.

The last preceding provision of this section relating to a particular agreement shall apply in the case of a tenancy under a contract of tenancy current at the commencement of this Act in respect of an improvement mentioned in the third part of the First Schedule hereto, specific compensation for which is not provided by any agreement in writing, or custom, or the Agricultural Holdings Act, 1875.

Regulations as to Compensation for Improvements.

6. *Regulations as to compensation for improvements.*—In the ascertainment of the amount of the compensation under this Act payable to the tenant in respect of any improvement there shall be taken into account in reduction thereof:

(*a.*) Any benefit which the landlord has given or allowed to the tenant in consideration of the tenant executing the improvement; and

(*b.*) In the case of compensation for manures the value of the manure that would have been produced by the consumption on the holding of any hay, straw, roots, or green crops sold off or removed from the holding within the last two years of the tenancy or other less time for which the tenancy has endured, except as far as a proper return of manure to the holding has been made in respect of such produce so sold off or removed therefrom; and

(*c.*) Any sums due to the landlord in respect of rent or in respect of any waste committed or permitted by the tenant, or in respect of any breach of covenant or other agreement connected with the contract of tenancy committed by the tenant, also any taxes, rates, and tithe rentcharge due or becoming due in respect of the holding to which the tenant is liable as between him and the landlord.

There shall be taken into account in augmentation of the tenant's compensation—

(*d.*) Any sum due to the tenant for compensation in respect of a breach or covenant or other agreement connected with a contract of tenancy and committed by the landlord.

Nothing in this section shall enable a landlord to obtain under this Act compensation in respect of waste by the tenant or of breach by the tenant committed or permitted in relation to a matter of husbandry more than four years before the determination of the tenancy.

Procedure.

7. *Notice of intended claim.*—A tenant claiming compensation under this Act shall, two months at least before the determination of the tenancy, give notice in writing to the landlord of his intention to make such claim.

Where a tenant gives such notice, the landlord may, before the determination of the tenancy, or within fourteen days thereafter, give a counter-notice in writing to the tenant of his intention to make a claim in respect of any waste or any breach of covenant or other agreement.

Every such notice and counter-notice shall state, as far as reasonably may be, the particulars and amount of the intended claim.

8. *Compensation agreed or settled by reference.*—The landlord and the tenant may agree on the amount and mode and time of payment of compensation to be paid under this Act.

If in any case they do not so agree the difference shall be settled by a reference.

9. *Appointment of referee or referees and umpire.*—Where there is a reference under this Act, a referee, or two referees and an umpire, shall be appointed as follows:—

(1.) If the parties concur, there may be a single referee appointed by them jointly:

(2.) If before award the single referee dies or becomes incapable of acting, or for seven days after notice from the parties, or either of them, requiring him to act, fails to act, the proceedings shall begin afresh, as if no referee had been appointed:

(3.) If the parties do not concur in the appointment of a single referee, each of them shall appoint a referee:

(4.) If before award one of two referees dies or becomes incapable of acting, or for seven days after notice from either party requiring him to act, fails to act, the party appointing him shall appoint another referee:

(5.) Notice of every appointment of a referee by either party shall be given to the other party:

(6.) If for fourteen days after notice by one party to the other to appoint a referee, or another referee, the other party fails to do so, then, on the application of the party giving notice, the county court shall within fourteen days appoint a competent and impartial person to be a referee:

(7.) Where two referees are appointed, then (subject to the provisions of this Act) they shall before they enter on the reference appoint an umpire:

(8.) If before award an umpire dies or becomes incapable of acting, the referees shall appoint another umpire:

(9.) If for seven days after request from either party the referees fail to appoint an umpire, or another umpire, then, on the application of either party, the county court shall within fourteen days appoint a competen and impartial person to be the umpire.

(10.) Every appointment, notice, and request under this section shall be in writing.

10. *Requisition for appointment of umpire by Land Commissioners, &c.*—Provided that, where two referees are appointed, an umpire may be appointed as follows:—

(1.) If either party, on appointing a referee, requires, by notice in writing to the other, that the umpire shall be appointed by the Land Commissioners for England, then the umpire, and any successor to him, shall be appointed, on the application of either party, by those commissioners.

(2.) In every other case, if either party on appointing a referee requires, by notice in writing to the other, that the umpire shall be appointed by the county court, then, unless the other party dissents by notice in writing therefrom, the umpire, and any successor to him, shall on the application of either party be so appointed, and in case of such dissent the umpire, and any successor to him, shall be appointed, on the application of either party, by the Land Commissioners for England.

11. *Exercise of powers of county court.*—The powers of the county court under this Act relative to the appointment of a referee or umpire shall be exercisable by the judge of the court having jurisdiction, whether he is without or within his district, and may, by consent of the parties, be exercised by the registrar of the court.

12. *Mode of submission to reference.*—The delivery to a referee of his appointment shall be deemed a submission to a reference by the party delivering it; and neither party shall have power to revoke a submission, or the appointment of a referee, without the consent of the other.

13. *Power for referee, &c., to require production of documents, administer oaths, &c.*—The referee or referees or umpire may call for the production of any sample, or voucher, or other document, or other evidence which is in the possession or power of either party, or which either party can produce, and which to the referee or referees or umpire seems necessary for determination of the matters referred, and may take the examination of the parties and witnesses on oath, and may administer oaths and take affirmations; and if any person so sworn or affirming wilfully and corruptly gives false evidence he shall be guilty of perjury.

14. *Power to proceed in absence.*—The referee or referees or umpire may proceed in the absence of either party where the same appears to him or them expedient, after notice given to the parties.

15. *Form of award.*—The award shall be in writing, signed by the referee or referees or umpire.

16. *Time for award of referee or referees.*—A single referee shall make his award ready for delivery within twenty-eight days after his appointment.

Two referees shall make their award ready for delivery within twenty-eight days after the appointment of the last appointed of them, or within such extended time (if any) as they from time to time jointly fix by writing under their hands, so that they make their award ready for delivery within a time not exceeding in the whole forty-nine days after the appointment of the last appointed of them.

17. *Award in respect of compensation under ss.* 3, 4, *and* 5.—In any case provided for by sections three, four, or five, if compensation is claimed under this Act, such compensation as under any of those sections is to be deemed to be substituted for compensation under this Act, if, and so far as the same can, consistently with the terms of the agreement, if any, be ascertained by the referees or the umpire, shall be awarded in respect of any improvements thereby provided for, and the award shall, when necessary, distinguish such improvements and the amount awarded in respect thereof; and an award given under this section shall be subject to the appeal provided by this Act.

18. *Reference to and award by umpire.*—Where two referees are appointed and act, if they fail to make their award ready for delivery within the time aforesaid, then, on the expiration of that time, their authority shall cease, and thereupon the matters referred to them shall stand referred to the umpire.

The umpire shall make his award ready for delivery within twenty-eight days after notice in writing given to him by either party or referee of the reference to him, or within such extended time (if any) as the registrar of the county court from time to time appoints, on the application of the umpire or of either party, made before the expiration of the time appointed by or extended under this section.

19. *Award to give particulars.*—The award shall not award a sum generally for compensation, but shall, so far as possible, specify—

(*a*.) The several improvements, acts, and things in respect whereof compensation is awarded, and the several matters and things taken into account under the provisions of this Act in reduction or augmentation of such compensation;

(*b*.) The time at which each improvement, act, or thing was executed, done, committed, or permitted;

(*c*.) The sum awarded in respect of each improvement, act, matter, and thing; and

(*d*.) Where the landlord desires to charge his estate with the amount of compensation found due to the tenant, the time at which, for the purposes of such charge, each improvement, act, or thing in respect of which compensation is awarded is to be deemed to be exhausted.

20. *Costs of reference.*—The costs of and attending the reference, including the remuneration of the referee or referees and umpire, where the umpire has been required to act, and including other proper expenses, shall be borne and paid by the parties in such proportion as to the referee or referees or umpire appears just, regard being had to the reasonableness or unreasonableness of the claim of either party in respect of amount, or otherwise, and to all the circumstances of the case.

The award may direct the payment of the whole or any part of the costs aforesaid by the one party to the other.

The costs aforesaid shall be subject to taxation by the registrar of the county court, on the application of either party, but that taxation shall be subject to review by the judge of the county court.

21. *Day for payment.*—The award shall fix a day, not sooner than one month after the delivery of the award, for the payment of money awarded for compensation, costs, or otherwise.

22. *Submission not to be removable, &c.*—A submission or award shall not be made a rule of any court, or be removable by any process into any court, and an award shall not be questioned otherwise than as provided by this Act.

23. *Appeal to county court.*—Where the sum claimed for compensation exceeds one hundred pounds, either party may, within seven days after delivery of the award, appeal against it to the judge of the county court on all or any of the following grounds:

1. That the award is invalid;
2. That the award proceeds wholly or in part upon an improper application of or upon the omission properly to apply the special provisions of sections three, four, or five of this Act;
3. That compensation has been awarded for improvements, acts, or things, breaches of covenants or agreements, or for committing or permitting waste, in respect of which the party claiming was not entitled to compensation;
4. That compensation has not been awarded for improvements, acts, or things, breaches of covenants or agreements, or for committing or permitting waste, in respect of which the party claiming was entitled to compensation;

and the judge shall hear and determine the appeal, and may, in his discretion, remit the case to be reheard as to the whole or any part thereof by the referee or referees or umpire, with such directions as he may think fit.

If no appeal is so brought, the award shall be final.

The decision of the judge of the county court on appeal shall be final, save that the judge shall, at the request of either party, state a special case on a question of law for the judgment of the High Court of Justice, and the decision of the High Court on the case, and respecting costs and any other matter connected therewith, shall be final, and the judge of the county court shall act thereon.

24. *Recovery of compensation.*—Where any money agreed or awarded or ordered on appeal to be paid for compensation, costs, or otherwise, is not paid within fourteen days after the time when it is agreed or awarded or ordered to be paid, it shall be recoverable upon order made by the judge of the county

court, as money ordered by a county court under its ordinary jurisdiction to be paid is recoverable.

25. *Appointment of guardian.*—Where a landlord or tenant is an infant without a guardian, or is of unsound mind, not so found by inquisition, the county court, on the application of any person interested, may appoint a guardian of the infant or person of unsound mind for the purposes of this Act, and may change the guardian if and as occasion requires.

26. *Provisions respecting married women.*—Where the appointment of a person to act as the next friend of a married woman is required for the purposes of this Act, the county court may make such appointment, and may remove or change that next friend if and as occasion requires.

A woman married before the commencement of the Married Women's Property Act, 1882 [45 & 46 Vict. c. 75], entitled for her separate use to land, her title to which accrued before such commencement as aforesaid, and not restrained from anticipation, shall, for the purposes of this Act, be in respect of land as if she was unmarried.

Where any other woman married before the commencement of the Married Women's Property Act, 1882, is desirous of doing any act under this Act in respect of land, her title to which accrued before such commencement as aforesaid, her husband's concurrence shall be requisite, and she shall be examined apart from him by the county court, or by the judge of the county court for the place where she for the time being is, touching her knowledge of the nature and effect of the intended act, and it shall be ascertained that she is acting freely and voluntarily.

27. *Costs in county court.*—The costs of proceedings in the county court under this Act shall be in the discretion of the court.

The Lord Chancellor may from time to time prescribe a scale of costs for those proceedings, and of costs to be taxed by the registrar of the court.

28. *Service of notice, &c.*—Any notice, request, demand, or other instrument under this Act may be served on the person to whom it is to be given, either personally or by leaving it for him at his last known place of abode in England, or by sending it through the post in a registered letter addressed to him there; and if so sent by post it shall be deemed to have been served at the time when the letter containing it would be delivered in ordinary course; and in order to prove service by letter it shall be sufficient to prove that the letter was properly addressed and posted, and that it contained the notice, request, demand, or other instrument to be served.

Charge of Tenant's Compensation.

29. *Power for landlord on paying compensation to obtain charge.*—A landlord, on paying to the tenant the amount due to him in respect of compensation under this Act, or in respect of compensation authorised by this Act to be substituted for compensation under this Act, or on expending such amount as may be necessary to execute an improvement under the second part of the First Schedule hereto, after notice given by the tenant of his intention to execute such improvement in accordance with this Act, shall be entitled to obtain from the county court a charge on the holding, or any part thereof, to the amount of the sum so paid or expended.

The court shall, on proof of the payment or expenditure, and on being satisfied of the observance in good faith by the parties of the conditions imposed by this Act, make an order charging the holding, or any part thereof, with repayment of the amount paid or expended, with such interest, and by such instalments, and with such directions for giving effect to the charge, as the court thinks fit.

But, where the landlord obtaining the charge is not absolute owner of the holding for his own benefit, no instalment or interest shall be made payable

after the time when the improvement in respect whereof compensation is paid will, where an award has been made, be taken to have been exhausted according to the declaration of the award, and in any other case after the time when any such improvement will in the opinion of the court, after hearing such evidence (if any) as it thinks expedient, have become exhausted.

The instalments and interest shall be charged in favour of the landlord, his executors, administrators, and assigns.

The estate or interest of any landlord holding for an estate or interest determinable or liable to forfeiture by reason of his creating or suffering any charge thereon shall not be determined or forfeited by reason of his obtaining a charge under this Act, anything in any deed, will, or other instrument to the contrary thereof notwithstanding.

Capital money arising under the Settled Land Act, 1882 [45 & 46 Vict. c. 38], may be applied in payment of any moneys expended and costs incurred by a landlord under or in pursuance of this Act in or about the execution of any improvement mentioned in the first or second parts of the schedule hereto, as for an improvement authorised by the said Settled Land Act; and such money may also be applied in discharge of any charge created on a holding under or in pursuance of this Act in respect of any such improvement as aforesaid, as in discharge of an incumbrance authorised by the said Settled Land Act to be discharged out of such capital money.

30. *Incidence of charge.*—The sum charged by the order of a county court under this Act shall be a charge on the holding, or the part thereof charged, for the landlord's interest therein, and for all interests therein subsequent to that of the landlord; but so that the charge shall not extend beyond the interest of the landlord, his executors, administrators, and assigns, in the tenancy where the landlord is himself a tenant of the holding.

31. *Provision in case of trustee.*—Where the landlord is a person entitled to receive the rents and profits of any holding as trustee, or in any character otherwise than for his own benefit, the amount due from such landlord in respect of compensation under this Act, or in respect of compensation authorised by this Act to be substituted for compensation under this Act, shall be charged and recovered as follows and not otherwise; (that is to say,)

(1.) The amount so due shall not be recovered personally against such landlord, nor shall he be under any liability to pay such amount, but the same shall be a charge on and recoverable against the holding only.

(2.) Such landlord shall, either before or after having paid to the tenant the amount due to him, be entitled to obtain from the county court a charge on the holding to the amount of the sum required to be paid or which has been paid, as the case may be, to the tenant.

(3.) If such landlord neglect or fail within one month after the tenant has quitted his holding to pay to the tenant the amount due to him, then after the expiration of such one month the tenant shall be entitled to obtain from the county court in favour of himself, his executors, administrators, and assigns, a charge on the holding to the amount of the sum due to him, and of all costs properly incurred by him in obtaining the charge or in raising the amount due thereunder.

(4.) The court shall on proof of the tenant's title to have a charge made in his favour make an order charging the holding with payment of the amount of the charge, including costs, in like manner and form as in case of a charge which a landlord is entitled to obtain.

32. *Advance made by a company.*—Any company now or hereafter incorporated by Parliament, and having power to advance money for the improvement of land, may take an assignment of any charge made by a county court under the provisions of this Act, upon such terms and conditions as may be agreed upon between such company and the person entitled to such charge;

and such company may assign any charge so acquired by them to any person or persons whomsoever.

Notice to Quit.

33. *Time of notice to quit.*—Where a half-year's notice, expiring with a year of tenancy, is by law necessary and sufficient for determination of a tenancy from year to year, in the case of any such tenancy under a contract of tenancy made either before or after the commencement of this Act, a year's notice so expiring shall by virtue of this Act be necessary and sufficient for the same, unless the landlord and tenant of the holding, by writing under their hands, agree that this section shall not apply, in which case a half-year's notice shall continue to be sufficient; but nothing in this section shall extend to a case where the tenant is adjudged bankrupt, or has filed a petition for a composition or arrangement with his creditors.

Fixtures.

34. *Tenant's property in fixtures, machinery, &c.*—Where after the commencement of this Act a tenant affixes to his holding any engine, machinery, fencing, or other fixture, or erects any building for which he is not under this Act or otherwise entitled to compensation, and which is not so affixed or erected in pursuance of some obligation in that behalf or instead of some fixture or building belonging to the landlord, then such fixture or building shall be the property of and be removable by the tenant before or within a reasonable time after the termination of the tenancy.

Provided as follows:—

1. Before the removal of any fixture or building the tenant shall pay all rent owing by him, and shall perform or satisfy all other his obligations to the landlord in respect to the holding:
2. In the removal of any fixture or building the tenant shall not do any avoidable damage to any other building or other part of the holding:
3. Immediately after the removal of any fixture or building the tenant shall make good all damage occasioned to any other building or other part of the holding by the removal:
4. The tenant shall not remove any fixture or building without giving one month's previous notice in writing to the landlord of the intention of the tenant to remove it:
5. At any time before the expiration of the notice of removal the landlord, by notice in writing given by him to the tenant, may elect to purchase any fixture or building comprised in the notice of removal, and any fixture or building thus elected to be purchased shall be left by the tenant, and shall become the property of the landlord, who shall pay the tenant the fair value thereof to an incoming tenant of the holding: and any difference as to the value shall be settled by a reference under this Act, as in case of compensation (but without appeal).

Crown and Duchy Lands.

35. *Application of Act to Crown lands.*—This Act shall extend and apply to land belonging to Her Majesty the Queen, her heirs and successors, in right of the Crown.

With respect to such land, for the purposes of this Act, the Commissioners of Her Majesty's Woods, Forests, and Land Revenues, or one of them, or other the proper officer or body having charge of such land for the time being, or in case there is no such officer or body, then such person as her Majesty, her heirs or successors, may appoint in writing under the Royal Sign Manual,

shall represent Her Majesty, her heirs and successors, and shall be deemed to be the landlord.

Any compensation payable under this Act by the Commissioners of Her Majesty's Woods, Forests, and Land Revenues, or either of them, in respect of an improvement mentioned in the first or second part of the First Schedule hereto, shall be deemed to be payable in respect of an improvement of land within section one of the Crown Lands Act, 1866, and the amount thereof shall be charged and repaid as in that section provided with respect to the costs, charges, and expenses therein mentioned.

Any compensation payable under this Act by those Commissioners, or either of them, in respect of an improvement mentioned in the third part of the First Schedule hereto, shall be deemed to be part of the expenses of the management of the Land Revenues of the Crown, and shall be payable to those Commissioners out of such money and in such manner as the last-mentioned expenses are by law payable.

36. *Application of Act to land of Duchy of Lancaster.*—This Act shall extend and apply to land belonging to Her Majesty, her heirs and successors, in right of the Duchy of Lancaster.

With respect to such land for the purposes of this Act, the Chancellor for the time being of the Duchy shall represent Her Majesty, her heirs and successors, and shall be deemed to be the landlord.

The amount of any compensation payable under this Act by the Chancellor of the Duchy in respect of an improvement mentioned in the first or second part of the First Schedule to this Act shall be deemed to be an expense incurred in improvement of land belonging to Her Majesty, her heirs or successors, in right of the Duchy, within section twenty-five of the Act of the fifty-seventh year of King George the Third, chapter ninety-seven, and shall be raised and paid as in that section provided with respect to the expenses therein mentioned.

The amount of any compensation payable under this Act by the Chancellor of the Duchy in respect of an improvement mentioned in the third part of the First Schedule to this Act shall be paid out of the annual revenues of the Duchy.

37. *Application of Act to land of Duchy of Cornwall.*—This Act shall extend and apply to land belonging to the Duchy of Cornwall.

With respect to such land, for the purposes of this Act, such person as the Duke of Cornwall for the time being, or other the personage for the time being entitled to the revenues and possessions of the Duchy of Cornwall, from time to time, by sign manual, warrant, or otherwise, appoints, shall represent the Duke of Cornwall or other the personage aforesaid, and be deemed to be the landlord, and may do any act or thing under this Act which a landlord is authorised or required to do thereunder.

Any compensation payable under this Act by the Duke of Cornwall, or other the personage aforesaid, in respect of an improvement mentioned in the first or second part of the First Schedule to this Act shall be deemed to be payable in respect of an improvement of land within section eight of the Duchy of Cornwall Management Act, 1863 [26 & 27 Vict. c. 49], and the amount thereof may be advanced and paid from the money mentioned in that section, subject to the provision therein made for repayment of sums advanced for improvements.

Ecclesiastical and Charity Lands.

38. *Landlord, archbishop or bishop.*—Where lands are assigned or secured as the endowment of a see, the powers by this Act conferred on a landlord shall not be exercised by the archbishop or bishop, in respect of those lands, except with the previous approval in writing of the Estates Committee of the Ecclesiastical Commissioners for England.

39. *Landlord, incumbent of benefice.*—Where a landlord is incumbent of an ecclesiastical benefice, the powers by this Act conferred on a landlord shall not be exercised by him in respect of the glebe land or other land belonging to the benefice, except with the previous approval in writing of the patron of the benefice, that is, the person, officer, or authority who, in case the benefice were vacant, would be entitled to present thereto, or of the Governors of Queen Anne's Bounty (that is, the Governors of the Bounty of Queen Anne for the Augmentation of the Maintenance of the Poor Clergy).

In every such case the Governors of Queen Anne's Bounty may, if they think fit, on behalf of the incumbent, out of any money in their hands, pay to the tenant the amount of compensation due to him under this Act; and thereupon they may, instead of the incumbent, obtain from the county court a charge on the holding, in respect thereof, in favour of themselves.

Every such charge shall be effectual, notwithstanding any change of the incumbent.

40. *Landlord, charity trustees, &c.*—The powers by this Act conferred on a landlord in respect of charging the land shall not be exercised by trustees for ecclesiastical or charitable purposes, except with the previous approval in writing of the Charity Commissioners for England and Wales.

Resumption for Improvements, and Miscellaneous.

41. *Resumption of possession for cottages, &c.*—Where on a tenancy from year to year a notice to quit is given by the landlord with a view to the use of land for any of the following purposes:

The erection of farm-labourers' cottages or other houses, with or without gardens;

The providing of gardens for existing farm-labourers' cottages or other houses;

The allotment for labourers of land for gardens or other purposes;

The planting of trees;

The opening or working of any coal, ironstone, limestone, or other mineral, or of a stone quarry, clay, sand, or gravel pit, or the construction of any works or buildings to be used in connection therewith;

The obtaining of brick-earth, gravel, or sand;

The making of a watercourse or reservoir;

The making of any road, railway, tramroad, siding, canal, or basin, or any wharf, pier, or other work connected therewith;

and the notice to quit so states, then it shall, by virtue of this Act, be no objection to the notice that it relates to part only of the holding.

In every such case the provisions of this Act respecting compensation shall apply as on determination of a tenancy in respect of an entire holding.

The tenant shall also be entitled to a proportionate reduction of rent in respect of the land comprised in the notice to quit, and in respect of any depreciation of the value to him of the residue of the holding, caused by the withdrawal of that land from the holding or by the use to be made thereof, and the amount of that reduction shall be ascertained by agreement or settled by a reference under this Act, as in case of compensation (but without appeal).

The tenant shall further be entitled, at any time within twenty-eight days after service of the notice to quit, to serve on the landlord a notice in wr ting to the effect that he (the tenant) accepts the same as a notice to quit the entire holding, to take effect at the expiration of the then current year of tenancy; and the notice to quit shall have effect accordingly.

42. *Provision as to limited owners.*—Subject to the provisions of this Act in relation to Crown, duchy, ecclesiastical, and charity lands, a landlord, whatever may be his estate or interest in his holding, may give any consent,

make any agreement, or do or have done to him any act in relation to improvements in respect of which compensation is payable under this Act which he might give or make or do or have done to him if he were in the case of an estate of inheritance owner thereof in fee, and in the case of a leasehold possessed of the whole estate in the leasehold.

43. *Provision in case of reservation of rent.*—When, by any Act of Parliament, deed, or other instrument, a lease of a holding is authorised to be made, provided that the best rent, or reservation in the nature of rent, is by such lease reserved, then, whenever any lease of a holding is, under such authority, made to the tenant of the same, it shall not be necessary, in estimating such rent or reservation, to take into account against the tenant the increase (if any) in the value of such holding arising from any improvements made or paid for by him on such holding.

PART II.

Distress.

44. *Limitation of distress in respect of amount and time.*—After the commencement of this Act it shall not be lawful for any landlord entitled to the rent of any holding to which this Act applies to distrain for rent, which became due in respect of such holding, more than one year before the making of such distress, except in the case of arrears of rent in respect of a holding to which this Act applies existing at the time of the passing of this Act, which arrears shall be recoverable by distress up to the first day of January one thousand eight hundred and eighty-five to the same extent as if this Act had not passed.

Provided that where it appears that according to the ordinary course of dealing between the landlord and tenant of a holding the payment of the rent of such holding has been allowed to be deferred until the expiration of a quarter of a year or half a year after the date at which such rent legally became due, then for the purpose of this section the rent of such holding shall be deemed to have become due at the expiration of such quarter or half year as aforesaid, as the case may be, and not at the date at which it legally became due.

45. *Limitation of distress in respect of things to be distrained.*—Where live stock belonging to another person has been taken in by the tenant of a holding to which this Act applies to be fed at a fair price agreed to be paid for such feeding by the owner of such stock to the tenant, such stock shall not be distrained by the landlord for rent where there is other sufficient distress to be found, and if so distrained by reason of other sufficient distress not being found, there shall not be recovered by such distress a sum exceeding the amount of the price so agreed to be paid for the feeding, or if any part of such price has been paid exceeding the amount remaining unpaid, and it shall be lawful for the owner of such stock, at any time before it is sold, to redeem such stock by paying to the distrainer a sum equal to such price as aforesaid, and any payment so made to the distrainer shall be in full discharge as against the tenant of any sum of the like amount which would be otherwise due from the owner of the stock to the tenant in respect of the price of feeding: Provided always, that so long as any portion of such live stock shall remain on the said holding the right to distrain such portion shall continue to the full extent of the price originally agreed to be paid for the feeding of the whole of such live stock, or if part of such price has been *bonâ fide* paid to the tenant under the agreement, then to the full extent of the price then remaining unpaid.

Agricultural or other machinery which is the *bonâ fide* property of a person other than the tenant, and is on the premises of the tenant under a

bonâ fide agreement with him for the hire or use thereof in the conduct of his business, and live stock of all kinds which is the *bonâ fide* property of a person other than the tenant, and is on the premises of the tenant solely for breeding purposes, shall not be distrained for rent in arrear.

46. *Remedy for wrongful distress under this Act.*—Where any dispute arises—

(*a*) In respect of any distress having been levied contrary to the provisions of this Act; or

(*b*) As to the ownership of any live stock distrained, or as to the price to be paid for the feeding of such stock; or

(*c*) As to any other matter or thing relating to a distress on a holding to which this Act applies:

such dispute may be heard and determined by the county court or by a court of summary jurisdiction, and any such county court or court of summary jurisdiction may make an order for restoration of any live stock or things unlawfully distrained, or may declare the price agreed to be paid in the case where price of the feeding is required to be ascertained, or may make any other order which justice requires: any such dispute as mentioned in this section shall be deemed to be a matter in which a court of summary jurisdiction has authority by law to make an order on complaint in pursuance of the Summary Jurisdiction Acts; but any person aggrieved by any decision of such court of summary jurisdiction under this section may, on giving such security to the other party as the court may think just, appeal to a court of general or quarter sessions.

47. *Set-off of compensation against rent.*—Where the compensation due under this Act, or under any custom or contract, to a tenant has been ascertained before the landlord distrains for rent due, the amount of such compensation may be set off against the rent due, and the landlord shall not be entitled to distrain for more than the balance.

48. *Exclusion of certiorari.*—An order of the county court or of a court of summary jurisdiction under this Act shall not be quashed for want of form, or be removed by certiorari or otherwise into any superior court.

49. *Limitation of costs in case of distress.*—No person whatsoever making any distress for rent on a holding to which this Act applies when the sum demanded and due shall exceed the sum of twenty pounds for or in respect of such rent shall be entitled to any other or more costs and charges for and in respect of such distress or any matter or thing done therein than such as are fixed and set forth in the Second Schedule hereto.

50. *Repeal of* 2 *W. and M. c.* 5 *s.* 1 *as to appraisement and sale at public auction.*—So much of an Act passed in the second year of the reign of their Majesties King William the Third and Mary, chapter five, as requires appraisement before sale of goods distrained is hereby repealed as respects any holding to which this Act applies, and the landlord or other person levying a distress on such holding may sell the goods and chattels distrained without causing them to be previously appraised; and for the purposes of sale the goods and chattels distrained shall, at the request in writing of the tenant or owner of such goods and chattels, be removed to a public auction room or to some other fit and proper place specified in such request, and be there sold. The costs and expenses attending any such removal, and any damage to the goods and chattels arising therefrom, shall be borne and paid by the party requesting the removal.

51. *Extension of time to replevy at request of tenant.*—The period of five days provided in the said Act of William and Mary, chapter five, within which the tenant or owner of goods and chattels distrained may replevy the same shall, in the case of any distress on a holding to which this Act applies, be extended to a period of not more than fifteen days, if the tenant or such

owner make a request in writing in that behalf to the landlord or other person levying the distress, and also give security for any additional costs that may be occasioned by such extension of time. Provided that the landlord or person levying the distress may, at the written request or with the written consent of the tenant, or such owner as aforesaid, sell the goods and chattels distrained or part of them at any time before the expiration of such extended period as aforesaid.

52. *Bailiffs to be appointed by county court judges.*—From and after the commencement of this Act no person shall act as bailiff to levy any distress on any holding to which this Act applies unless he shall be authorised to act as bailiff by a certificate in writing under the hand of the judge of a county court; and every county court judge shall, on or before the thirty-first day of December one thousand eight hundred and eighty-three, and afterwards from time to time as occasion shall require, appoint a competent number of fit and proper persons to act as such bailiffs as aforesaid. If any person so appointed shall be proved to the satisfaction of the said judge to have been guilty of any extortion or other misconduct in the execution of his duty as a bailiff, he shall be liable to have his appointment summarily cancelled by the said judge.

PART III.

General Provisions.

53. *Commencement of Act.*—This Act shall come into force on the first day of January one thousand eight hundred and eighty-four, which day is in this Act referred to as the commencement of this Act.

54. *Holdings to which Act applies.*—Nothing in this Act shall apply to a holding that is not either wholly agricultural or wholly pastoral, or in part agricultural, and as to the residue pastoral, or in whole or in part cultivated as a market garden, or to any holding let to the tenant during his continuance in any office, appointment, or employment held under the landlord.

55. *Avoidance of agreement inconsistent with Act.*—Any contract, agreement, or covenant made by a tenant, by virtue of which he is deprived of his right to claim compensation under this Act in respect of any improvement mentioned in the First Schedule hereto (except an agreement providing such compensation as is by this Act permitted to be substituted for compensation under this Act), shall, so far as it deprives him of such right, be void both at law and in equity.

56. *Right of tenant in respect of improvement purchased from outgoing tenant.*—Where an incoming tenant has, with the consent in writing of his landlord, paid to an outgoing tenant any compensation payable under or in pursuance of this Act in respect of the whole or part of any improvement, such incoming tenant shall be entitled on quitting the holding to claim compensation in respect of such improvement or part in like manner, if at all, as the outgoing tenant would have been entitled if he had remained tenant of the holding, and quitted the holding at the time at which the incoming tenant quits the same.

57. *Compensation under this Act to be exclusive.*—A tenant shall not be entitled to claim compensation by custom or otherwise than in manner authorised by this Act in respect of any improvement for which he is entitled to compensation under or in pursuance of this Act, but where he is not entitled to compensation under or in pursuance of this Act he may recover compensation under any other Act of Parliament, or any agreement or custom, in the same manner as if this Act had not passed.

58. *Provision as to change of tenancy.*—A tenant who has remained in his holding during a change or changes of tenancy shall not thereafter on

quitting his holding at the determination of a tenancy be deprived of his right to claim compensation in respect of improvements by reason only that such improvements were made during a former tenancy or tenancies, and not during the tenancy at the determination of which he is quitting.

59. *Restriction in respect of improvements by tenant about to quit.*—Subject as in this section mentioned, a tenant shall not be entitled to compensation in respect of any improvements, other than manures as defined by this Act, begun by him, if he holds from year to year, within one year before he quits his holding, or at any time after he has given or received final notice to quit, and, if he holds as a lessee, within one year before the expiration of his lease.

A final notice to quit means a notice to quit which has not been waived or withdrawn, but has resulted in the tenant quitting his holding.

The foregoing provisions of this section shall not apply in the case of any such improvement as aforesaid—

(1.) Where a tenant from year to year has begun such improvement during the last year of his tenancy, and, in pursuance of a notice to quit hereafter given by the landlord, has quitted his holding at the expiration of that year; and

(2.) Where a tenant, whether a tenant from year to year or a lessee, previously to beginning any such improvement, has served notice on his landlord of his intention to begin the same, and the landlord has either assented or has failed for a month after the receipt of the notice to object to the making of the improvement.

60. *General saving of rights.*—Except as in this Act expressed, nothing in this Act shall take away, abridge, or prejudicially affect any power, right, or remedy of a landlord, tenant, or other person vested in or exerciseable by him by virtue of any other Act or law, or under any custom of the country, or otherwise, in respect of a contract of tenancy or other contract, or of any improvements, waste emblements, tillages, away-going crops, fixtures, tax, rate, tithe rentcharge, rent, or other thing.

61. *Interpretation.*—In this Act—

"Contract of tenancy" means a letting of or agreement for the letting land for a term of years, or for lives, or for lives and years, or from year to year:

A tenancy from year to year under a contract of tenancy current at the commencement of the Act shall for the purposes of this Act be deemed to continue to be a tenancy under a contract of tenancy current at the commencement of this Act until the first day on which either the landlord or tenant of such tenancy could, the one by giving notice to the other immediately after the commencement of this Act, cause such tenancy to determine, and on and after such day as aforesaid shall be deemed to be a tenancy under a contract of tenancy beginning after the commencement of this Act:

"Determination of tenancy" means the cesser of a contract of tenancy by reason of effluxion of time, or from any other cause:

"Landlord" in relation to a holding means any person for the time being entitled to receive the rents and profits of any holding:

"Tenant" means the holder of land under a landlord for a term of years, or for lives, or for lives and years, or from year to year:

"Tenant" includes the executors, administrators, assigns, legatee, devisee, or next-of-kin, husband, guardian, committee of the estate or trustees in bankruptcy of a tenant, or any person deriving title from a tenant; and the right to receive compensation in respect of any improvement made by a tenant shall enure to the benefit of such executors, administrators, assigns, and other persons as aforesaid:

"Holding" means any parcel of land held by a tenant:

"County court," in relation to a holding, means the county court within the district whereof the holding or the larger part thereof is situate:

"Person" includes a body of persons and a corporation aggregate or sole:

"Live stock" includes any animal capable of being distrained:

"Manures" means any of the improvements numbered twenty-two and twenty-three in the third part of the First Schedule hereto:

The designations of landlord and tenant shall continue to apply to the parties until the conclusion of any proceedings taken under or in pursuance of this Act in respect of compensation for improvements, or under any agreement made in pursuance of this Act.

62. *Repeal of Acts of* 1875 *and* 1876.—On and after the commencement of this Act, the Agricultural Holdings (England) Act, 1875, and the Agricultural Holdings (England) Act, 1875, Amendment Act, 1876, shall be repealed.

Provided that such repeal shall not affect—

(*a.*) any thing duly done or suffered, or any proceedings pending under or in pursuance of any enactment hereby repealed; or

(*b.*) any right to compensation in respect of improvements to which the Agricultural Holdings (England) Act, 1875, applies, and which were executed before the commencement of this Act; or

(*c.*) any right to compensation in respect of any improvement to which the Agricultural Holdings (England) Act, 1875, applies, although executed by a tenant after the commencement of this Act if made under a contract of tenancy current at the commencement of this Act; or

(*d.*) any right in respect of fixtures affixed to a holding before the commencement of this Act;

and any right reserved by this section may be enforced after the commencement of this Act in the same manner in all respects as if no such repeal had taken place.

63. *Short title of Act.*—This Act may be cited for all purposes as the Agricultural Holdings (England) Act, 1883.

64. *Limits of Act.*—This Act shall not apply to Scotland or Ireland.

FIRST SCHEDULE.

PART I.

IMPROVEMENTS TO WHICH CONSENT OF LANDLORD IS REQUIRED.

(1.) Erection or enlargement of buildings.
(2.) Formation of silos.
(3.) Laying down of permanent pasture.
(4.) Making and planting of osier beds.
(5.) Making of water meadows or works of irrigation.
(6.) Making of gardens.
(7.) Making or improving of roads or bridges.
(8.) Making or improving of watercourses, ponds, wells, or reservoirs, or of works for the application of water power or for supply of water for agricultural or domestic purposes.
(9.) Making of fences.
(10.) Planting of hops.
(11.) Planting of orchards or fruit bushes.
(12.) Reclaiming of waste land.
(13.) Warping of land.
(14.) Embankment and sluices against floods.

PART II.

IMPROVEMENT IN RESPECT OF WHICH NOTICE TO LANDLORD IS REQUIRED.

(15.) Drainage.

PART III.

IMPROVEMENTS TO WHICH CONSENT OF LANDLORD IS NOT REQUIRED.

(16.) Boning of land with undissolved bones.
(17.) Chalking of land.
(18.) Clay-burning.
(19.) Claying of land.
(20.) Liming of land.
(21.) Marling of land.
(22.) Application to land of purchased artificial or other purchased manure.
(23.) Consumption on the holding by cattle, sheep, or pigs of cake or other feeding stuff not produced on the holding.

SECOND SCHEDULE.

Section 49.—Levying distress. Three per centum on any sum exceeding 20*l.* and not exceeding 50*l.* Two and a half per centum on any sum exceeding 50*l.*

To bailiff for levy, 1*l.* 1*s.*

To man in possession, if boarded, 3*s.* 6*d.* per day; if not boarded, 5*s.* per day.

For advertisements the sum actually paid.

To auctioneer. For sale five pounds per centum on the sum realised not exceeding 100*l.*, and four per centum on any additional sum realised not exceeding 100*l.*, and on any sum exceeding 200*l.* three per centum. A fraction of 1*l.* to be in all cases considered 1*l.*

Reasonable costs and charges where distress is withdrawn or where no sale takes place, and for negotiations between landlord and tenant respecting the distress; such costs and charges in case the parties differ to be taxed by the registrar of the county court of the district in which the distress is made.

II.—*Improvement of the Plants of the Farm.* By HENRY EVERSHED.

MANY examples might be given of the modification of cultivated plants by the skill of improvers both in agriculture and horticulture. Few persons are ignorant of the plastic character of flowers, and the variety of forms and colours which have been developed by breeding and selection; and probably few are unaware of the increased productive powers of some of the plants of the farm in recent years; but comparatively few avail themselves of these improvements to their full extent.

A short and practical account of the actual achievements in plant improvement, including the methods by which they have been effected, will probably be more useful at the present time than a more elaborate inquiry. It may, in fact, be said, that

the "science" of this subject, that is the existing knowledge connected with it, consists in observations made in the field, rather than in the discoveries of the closet. In spite of investigations in morphology, and the invention of a name—protoplasm—for that which Professor Huxley calls "the physical basis of life," we can neither predict nor secure the behaviour of plants under all the varying circumstances which may affect them. If, however, we carefully watch their growth, and their external modifications under particular treatment or natural influences, we shall become "wise after the event," in the acquisition of knowledge useful to us as breeders and selectors. The admission of an eminent botanist strengthens my belief that the present narrative, addressed as it is to agriculturists, should consist mainly of a collection of facts, with the least possible discussion of the incomplete branches of scientific botany. Dr. Maxwell T. Masters, F.R.S., remarks,* "No doubt internal anatomical differences are even of greater moment than these external characteristics, but these demand minute comparative study by means of the microscope, under various conditions, and at different seasons, and constitute a branch of inquiry at present hardly even entered upon."

There is a close analogy in the variation of plants and animals under domestication. No one doubts that primæval forms of both have been altered greatly, and very much to the advantage of breeders and cultivators; that the process is still assiduously carried on in both departments, and that more prolific or productive breeds of cattle, sheep, cereals, and forage-plants may yet be found. Still, it seems desirable to refer briefly to the history of the subject for the sake of showing, so far as may be possible, the extent of the improvements that have been effected in plants, and the methods by which they have been accomplished.

If the pre-historic samples of small grains and ears can be relied on, no doubt can exist that cereals have been greatly improved since the period of the Lake-Dwellings of Switzerland.† Subsequent to the Stone period — an "immensely remote period," Mr. Darwin calls it—there has been a striking improvement in the cereals; and the peas and beans of the Bronze period were as inferior to the common pulse of the present time as the latter are to the superior varieties for which we are indebted to modern breeders and selectors.

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* "Plant Life." By Maxwell T. Masters, M.D., F.R.S. 'Handbook of the Farm' Series. Edited by J. Chalmers Morton. London: Bradbury, Agnew, and Co., 1883.

† 'Animals and Plants under Domestication.' By Charles Darwin, M.A., F.R.S., &c. Second Edition, 1875, vol. i. p. 336.

We are here specially interested in the plants of the farm, though many other plants have been "improved," in the sense of having become, under man's skilled manipulation, more useful to him, more profitable, or more beautiful. He has never handled them in vain, and the field of operation is still full of subjects ready for his moulding. "Accustomed as we are," says Mr. Darwin, "to our excellent vegetables and luscious fruits, we can hardly persuade ourselves that the stringy roots of the wild carrot and parsnip, or the little shoots of the wild asparagus, or crabs, sloes, &c., should ever have been valued; yet, from what we know of the habits of the Australian and South African savages, we need feel no doubt on this head. The inhabitants of Switzerland during the Stone period largely collected wild crabs, sloes, bullaces, hips of roses, elderberries, beech-mast, and other wild berries and fruit. Jemmy Button, a Fuegian on board the 'Beagle,' remarked to me that the poor and acid black currants of Terra del Fuego were too sweet for his taste."

This quotation may remind the improver that wild fruits all over the world appear to have been the first forms of food, and that all the excellent and productive crops of fields or gardens to which we are now accustomed in this and other countries are due to his predecessors. A list of writers who have explored the history of improvements in cultivated plants, from Virgil to De Candolle, will be found in Mr. Darwin's 'Animals and Plants under Domestication.' Attractive, however, as the subject of universal plant-improvement may be, the writer of these pages must confine himself to the few plants known in our rotations, with perhaps some slight reference to others in illustration of the general subject.

History and Methods of Plant Improvement: Cereals.—To Thomas Andrew Knight belongs the merit of first attempting the crossing of different varieties of wheat in this country; and he states that "in the years 1795 and 1796, when almost the whole corn of the island was blighted, the varieties thus obtained alone escaped in this neighbourhood when sown on different soils and situations." In 1851 Mr. Raynbird had the honour of being the first exhibitor of a cross-bred variety of wheat, which was obtained by fertilising Piper's Thickset with pollen from one of Mr. Patrick Shirreff's selections, the Houptoun. The first volume of this 'Journal' contained an account of Morton's Red-straw White-wheat, and numerous articles relating to the improvement of wheat have since appeared, from the "Report on Prize Wheat," in 1842, to a similar report on the "Competition for Seed-Wheat," by Mr. Carruthers, in 1881.

Colonel Le Couteur must be mentioned as a well-known

improver of wheat, and an admirable writer on the subject; and his pages, and those of many other writers in this 'Journal,' may be consulted with advantage. In the history of plant-improvement there is no lack of materials, especially as regards wheat, which our predecessors evidently regarded as the mainstay of their farming—the plant which, among all others, most deserved their care. The literature devoted to this particular cereal and its improvement during the present century has been immense, and most of the earlier volumes of this 'Journal' afford proof of the interest which trials of different sorts of wheat have attracted. It may also be mentioned, in reference to the history of attempted improvements, that samples are shown at the South Kensington Museum of different sorts of wheat collected by Sir Joseph Banks; and these may some day be useful in enabling the investigator to compare the sorts of the last century with those of a future period.

A prime object of improvers and selectors is to uphold the best types of each particular plant, that have been already attained, and, if possible, to advance them. It should be remembered that the agriculturist has no ally in the work that has been suggested. Nature lends him no aid, since she has no partialities. The principle of selection is a natural law, it is true, but Nature has no predilection for the improver's artificial selections; she does not care for his chosen forms of mangolds or turnips. In a struggle for existence with the natural vegetation which too often presses upon our cultivated plants, most of them would perish. They were produced by improvers, ancient or modern, and the preservation of their excellence, and, if possible, their further progress, are dependent on the continued exercise of the art that advanced them to the point they have already reached.

By the selection of profitable modifications, nature adapts both plants and animals to their surrounding circumstances; and by following the example, plant-improvers have moulded cultivated plants in the same manner. There are early and late, and northern and southern varieties, all produced by breeding and selection, and—to mention a very important branch of the art of "improving" plants—varieties have been produced to suit rich and poor soils, as well as high and low farming.

The maintenance of the breeds always engages a great deal of attention, and without great care in this respect, and in the introduction of new sorts, absolute degeneracy of the plants of the farm would occur. Mr. Patrick Shirreff, Mungoswells, Haddington, was one of the very numerous, known or unknown, improvers of the present century, making his first selection of wheat in 1819, and receiving a well-earned testimonial for his services as a plant-

improver towards the close of his life in 1876. In the case of nearly all our improved varieties of wheat, such as Chidham, which is said to have been found in a hedge, the circumstances of the discovery are unknown. Fortunately, Mr. Shirreff amused his declining years by writing, for distribution among his friends and patrons, a small volume,* in which he published the facts of his discoveries. As some of his varieties of wheat and oats were very widely distributed and are still popular, while others have almost disappeared, the history of his successes and failures must be full of instruction. I propose giving some of the main facts.

In 1813 Mr. Shirreff observed in one of his fields of wheat, which looked miserable from the effects of a severe winter, one green and spreading plant far more vigorous than the rest, having been endowed, we may suppose, with a stronger constitution. He manured this plant to increase its yield, and it proved to be a new and marked variety, with taller straw than Hunter's, and not so apt to lodge, and possessing, as its first appearance indicated, a remarkable tillering propensity. The new sort was put in the market as "Mungoswell's Wheat," and Mr. Shirreff was able to say in 1873 that it was still extensively grown in East Lothian.

In 1824 a tall oat-plant was selected, having straw longer than any of the named varieties which Mr. Shirreff grew in his collection, for the purpose of comparison. The grain was longer than that of the potato-oat, weighing well, and yielding meal unequalled in quality and whiteness. Besides the peculiarity of its length, the straw grew very irregular in height. This second of Mr. Shirreff's new varieties—the Hopetoun oat—is mentioned as a favourite by several of my correspondents, and is widely grown in Scotland, in the countries of the Baltic, and in parts of North America. It spread very rapidly, on its introduction by Mr. Shirreff, into the oat-growing districts here and abroad.

Several of my correspondents speak of "White Hunter's" wheat, which is really one of Mr. Shirreff's happy selections, named by him Hopetoun. He found it on the farm of Drem, near his own, in 1832, and it has since spread over a wide range of country and climate. I remember it in the south, with all the marked characteristics mentioned by Mr. Shirreff, the straw growing equal in length, so as to give a deceptive appearance of thickness of crop, the grain white, but changing in the south to a stronger colour.

The next novelty was Shirreff's oat, a marked and prolific

* 'Improvement of the Cereals.' By Patrick Shirreff. Edinburgh and London: William Blackwood and Sons, 1873.

variety, with level straw. In spite of its *sobriquet* of "Make-him-rich," this variety is now rarely found in its original district, though it is still popular elsewhere, and comes to Kelso market dubbed by the name just mentioned. After resting on his honours, Mr. Shirreff resumed a work which has proved of national benefit, and in 1856 a continued and systematic searching of the wheat-fields recommenced. Friends on both sides of the Tweed sent him specimens of ears differing from the general crop, and his trial-ground in 1857 contained plants from the seed of seventy selected ears. From these three kinds were selected, Shirreff's Bearded Red (a type of the Old Red Lammas), with long, slender, wiry straw; Pringle's wheat, with long stout straw; and Shirreff's Bearded White. Each of these had marked peculiarities in the grain as well as straw. Mr. Shirreff has carefully described his arrangements for the protection and separation of his trial-plots, and he found that the time occupied in sowing, harvesting, dressing, and weighing, compelled him to limit the size of his plots or the number of the trials, and that success was not likely to be attained without strict personal superintendence. The sorts were grown in parallel rows; and cross-breeding, under these circumstances, did not occur—an observation of great importance, agreeing with the general experience, and opposed to Mr. Knight's extraordinary assertion that, by sowing several sorts of wheat together, he obtained as many new varieties as he pleased. Cross-bred grains would, no doubt, yield a very mixed produce, and probably an expert would detect many different forms even in a field of pedigree-wheat; but these are not new varieties such as Mr. Knight had in view. The florets of wheat must, under ordinary circumstances, be self-fertilised, "for," if I may quote a written record of my personal observation in the field some years since, "the stamens are fully developed, and the pollen begins to shed before the florets expand, and their task is accomplished before they make their appearance outside the ear." The clouds of pollen therefore in a wheat-field are, like many other provisions for the security of reproduction, in excess of the customary requirements. They make assurance doubly sure, however, and they secure the occasional occurrence of crosses between neighbouring plants, which are probably not infrequent.

Among his selections Mr. Shirreff produced three oats, which he called the "Fellow Family," and they were as various in size, height, character, and constitution as any three members of any human family. "Long Fellow" has straw fine in quality, firm in texture, free of leaf; and it has a habit of slow growth in the early part of the season, until the appearance of the

ears, when the stalks push out and continue lengthening until the crop is ripe. These are very profitable characteristics, since they preserve the crop from becoming laid when that early broad-leaved sort, the Georgian, known as Canadian, with its early habit and poor quality of straw, would go down flat.

Mr. Shirreff gives an elaborate account of his cross-breeding. I must omit his description of the actual operation by which artificial fertilisation is effected. The mechanics of this subject can readily be mastered. The arrangement of the crosses is a more difficult matter, requiring much study, and perhaps as much time and special aptitude as in the case of breeding a herd or a flock. In this department Mr. Shirreff's success was limited. He obtained, for example, "King Richard," by fecundating Shirreff's Bearded White, which has small round seeds, with Talavera, which certainly has large seeds of the finest quality, calculated to correct a special defect in the Bearded White. But it was probably an error to use a tender wheat of Spanish extraction for breeding purposes in Scotland. Mr. Shirreff began his experiments in cross-breeding too late in life to be able to complete the continuous selecting which is necessary, as in other cross-breeding, to fix the type. In this direction the experiments of Mr. Shirreff cannot be regarded as complete, and although some of his favourite crosses were widely distributed, it is not surprising that his nephew, Mr. Charles S. Dods, of Haddington, should report their comparative disuse in competition with those admirable selections on which his celebrity now rests.

No recent experiments in the cross-breeding of cereals in Great Britain have been recognised, at least, upon our markets, since those of Mr. Shirreff. M. Henry Vilmorin has kindly given me the following account of his experiments in France :—

"My attempts to improve wheats by cross-fertilization have all been made in the last ten years, the first in 1873. The object being to raise sorts with a fine full kernel, and strong enough in the straw to carry the ears to the time of maturity without becoming laid, I selected generally a strong stiff kind for the mother plant, and a sort with a fine seed for the pollen bearer. Yet I generally crossed those two plants both ways, to secure an additional chance. The kind mostly used on account of its fine kernel was Blé blanc de Flandre; those selected on account of the stiff straw are—Blé roseau, Blé rouge de St. Laud, Blé de l'île de Noé. Sometimes the object was to increase the yield in straw of a kind that was almost perfect except on that one respect, as Chiddam *à épi rouge*, which was for that purpose crossed with Prince Albert. The operation in itself requires care and some dexterity, but is not really difficult. The anthers being removed from a dozen wheat flowers or so while still in a green state, but near maturity, the pollen of the kind which it is intended to use as male parent is poured gently, the next morning, on the feathery stigma, the flowers next to the impregnated ones being destroyed so as not to leave any doubt at maturity as to which seeds have been acted upon. Generally

ten or a dozen blooms only were impregnated in one ear. They were all sown during the next autumn, and the fixing of any form which seemed promising went on, simply under the process of selection. Only, in order not to overtask the memory, an ear was preserved of each form judged worthy of propagation, and was kept in a glass case, which was produced the next year at the time of selecting the plants, so that the individuals kept in each successive year were as like as possible to the one chosen at first. Four or five years' selections were necessary, on an average, to make each sort tolerably even and fixed."

I am indebted to Mr. Rimpau, of Schlanstedt, for a copy of a reprint of an article of his "On the Flowering of Cereals,' which was published last year in a well-known Prussian Agricultural Journal.* This is an exceedingly interesting and exhaustive article on what is known of the phenomena and processes of flowering of cereals, critical references being made to the writings of other investigators in the same direction. The author conducted an extensive series of observations and experiments on the relation of temperature and the swelling of the lodicules to the expansion of the flowers for fertilisation. Various kinds of wheat, rye, barley, and oats were experimented on. He found that the opening of the glumes of cereals, like all other physiological phenomena, is dependent on a certain temperature. That is to say, there is a *minimum* below which the flowers will not open; there is an *optimum* which most favours the phenomenon; and there is a *maximum* above which the flowers will not open at all. The swelling out of the lodicules, which is the ultimate cause of the opening of the glumes, is itself dependent on the temperature. Briefly, the opening of the flowers, and the consequently possible cross-fertilisation, is due to the swelling of the lodicules, acted upon by the temperature—the degree of swelling invariably corresponding to the angle of opening of the glumes—and after the act of impregnation the lodicules shrivel up and permit the glumes to close over the pistil. The author also treats of the inconstancy and liability to reversion of the earlier generations of undoubted crossed varieties. Two other useful articles by Mr. Rimpau, each published in the same Journal in 1877, are that "On Raising New Varieties of Cereals," which will be found at p. 193; and another "On Self-sterility of Rye," p. 1073. In reply to one of my printed questions, Mr. Rimpau states that in Germany the improvement of cereals by crossing and selection has been undertaken by Mr. F. Heine of Emersleben, near Halberstadt, who has raised by ear-selection a good variety of summer wheat.

English farmers may be gratified to learn that many of the

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* 'Landwirthschaftliche Jahrbücher' (1883), xi. pp. 875–919.

best sorts of cereals, and all the varieties of winter wheat have been introduced into Mr. Rimpau's district from this country.

In the United States several improvers have engaged in the cross-breeding of cereals in recent years, and the Hon. George B. Loring, Commissioner of the Department of Agriculture, Washington, has been good enough to send me an account of their experiments, prepared for me at his desire by Dr. Vasey, Botanist of the Department.

"The principal experiments in this direction made in this country are, first, those of Mr. C. G. Pringle, of Charlotte, Vermont, which are described at length in the Report of the Vermont Board of Agriculture for 1875–6. The following is an outline of his operations. He commenced his experiments in 1870 by impregnating a head of the Black Sea variety of wheat with pollen of the Golden Drop or Siberian. The fruit of that cross was sown the next spring and cultivated with the utmost care. 'The first year the several plants showed great uniformity of character. They were, speaking in a general way, intermediate between their parents. Except for a few short awns on the upper part of the heads, they were beardless like the Golden Drop, though they had sprung from seed borne on the Black Sea, a full-bearded variety; the chaff had taken a reddish tinge from the Black Sea, and the kernels were larger, plumper, and of lighter colour than those of that variety, evidently partaking strongly of the character of the Golden Drop. . . . The selected product of these plants was the second spring sown in drills, and kept separate by numbered stakes. As the plants grew luxuriantly and tillered freely, I counted on a rapid increase of my stock of these new varieties, which, judging from the character they exhibited the previous year, would beyond question be valuable gains to agriculture. But, as the heads issued from the sheath of the upper leaf, great was my astonishment and dismay to observe among the plants of each class a wide diversity of forms. There were heads of various lengths and of many forms; there were awnless heads, and heads bearded in every degree. When I saw this medley among my crosses I relinquished my expectation of speedy advantage from the experiment; and but for the aid which selection afforded me, would have remitted altogether a work involving so much care and patience, and yielding such perplexity and disappointment. Selecting therefore a few of the most distinct and promising forms, and beginning again the third year with the product of single plants as before, planting in separate drills, and if any sporting appeared in the drills (as was almost invariably the case, though the degree of variation became less and less), selecting from the drill in such event the best plant, the one which approached nearest the ideal appointed for that drill, to yield seed for the next year, I have succeeded after four years in fixing the character of several varieties. The sway of inheritance in them is no longer disputed, and they come true from seed.'

"Mr. Pringle made experiments with several other varieties of wheat and also with oats, and with corresponding results. It is perhaps yet too soon to estimate the value of his new varieties, but some of them have been widely distributed and have been highly commended, and are still in the markets.

"Second. Mr. A. E. Blount, of Colorado, has also made numerous experiments in hybridizing different varieties of wheat, and his experience is mainly a repetition of that of Mr. Pringle. Some account of his experiments is given in a recent address on the 'Improvement of the Cereals' before a Convention of Agriculturists in Washington, a copy of which will be sent to you.

"Third. Mr. Chas. Arnold, of Paris, Province of Ontario, Canada, has also

made prominent experiments in hybridizing wheat, but we have no printed account of the same."

Mr. Pringle has given up agriculture, and is now engaged in a botanical exploration of the Pacific Slope. His mantle has fallen on Mr. F. Horsford, Charlotte, Vermont, whose letter to me contains hints that may be useful to improvers. He writes:—

"Since 1878 I have given my entire attention to the study of botany and hybridizing. Have only sent out three novelties that are on the market, but it requires from three to six years in selecting in order to establish such in character. My experiments have been confined mostly to wheat, barley, tomatoes and peas. Last year I made in this way about seventy-five new crosses. The results of these I cannot report on until one or two years' trial. Those of former years have been quite satisfactory to me. I have seen great improvement in the yield of barley by crossing, more in this cereal than in wheat. From some experiments which I have made I am led to believe that great improvement in the yield of grains can be made by crossing individuals of the *same* variety. If these individuals are not closely related, or are from different districts, so much the better. I believe that by taking eight individuals of the same variety and from different districts, arranging them in pairs, crossing, and then recrossing these hybrids produced, bringing the eight together the third year, greater results may be obtained than by a long series of selections like those of Hallett's and others. There is not the variation in such crosses that we get by crossing different varieties, and a stack for general use can be had much sooner, though no change in quality of grain would be expected.

"In the summer of 1881 I crossed our common six-rowed barley, which is the same as the French call 'Escourgeon,' with the Nepal barley, which is beardless and hulless. My last year's plants of this hybrid were a pleasing surprise to me. The heads were much longer than either parent; beardless, but not hulless. The plants showed much vigour, which in this climate is lacking in the Nepal. Another hybrid between our common six-rowed *hulless* barley and the Nepal was equally interesting. The plants did not act like the former, but were a long time in tillering, and I had doubts of their producing any seed. After sending out three or four times as many stems as the former variety, these grew and produced good heads, which were beardless and hulless. The plants were hardly half as tall as either parent, but produced three times as many heads to the plant as any variety of corn which I had. The crossing seemed to have changed the height of the parents into tillering. Of course I may expect a great number of intermediate forms in the next year's crop of these varieties."

I believe that Dr. E. L. Sturtevant, of Geneva, New York, Director of the Experimental Station of that State, is also engaged in crossing cereals, and the object of all such experiments must be the production of beneficial variations. A good sort for America, however, would probably not prove a good sort for England, since the "improvement" of a cereal implies its adaptability to a particular soil and climate.

The history of maize offers an example of a plant which has travelled widely, through its inherent flexibility, or power of producing varieties adapted to new localities.

No one doubts that the numerous varieties of maize have descended from a single source. Yet this plant, once confined to one spot, now ranges through greater extremes of climate perhaps than any other grain-crop. Dr. Vasey, Botanist to the Department of Agriculture, Washington, has favoured me with the following reply to an inquiry as to the localities of the varieties of maize.

"Another enquiry is as follows:—'Are these different sorts of maize adapted to different districts, and can a definite line be drawn between the districts which produce the large, flat, rough seed, and those which produce the smooth, round, yellow seeds?' To this it may be answered that there are several varieties of each of the two classes of corn or maize referred to in the question, and that in general the large, rough-seeded varieties are best adapted to Southern districts, and the smaller, smooth round varieties to Northern districts; yet no definite line can be drawn farther, perhaps, than to say that the large varieties cultivated in the extreme South will not succeed in the extreme North, for the want of a sufficiently long season to mature the grain."

The varieties of maize and their differences may be studied in the first volume of Mr. Darwin's 'Animals and Plants under Domestication,' and in the works which he refers to; or a more popular work may be consulted—the 'Grain Manual'—published by Messrs. Hiram, Sibley and Co., the great seedsmen of Rochester and Chicago. In southern districts maize requires six or seven months as the period of its growth, while the dwarf kind, which are habituated to the short summer of the north, require only from three to four months. The height of the plant is 15 or 18 feet in some climates, and 16 or 18 inches in the case of dwarf varieties in northern countries. The size of the ear and of its seeds varies in like manner. There are kinds which ripen their seeds six weeks earlier than other kinds. Maize from the furthest south will hardly ripen a seed in New England, and the maize of New England will scarcely ripen in Canada. But with care and culture the southern kinds, after a few years, ripen their seeds perfectly in their northern homes, furnishing, as Mr. Darwin observes, "an analogous case to the conversion of summer into winter wheat, and conversely."

The principle of selection has been applied to rice as well as maize, and among various other cases in point, I may quote that of the Chinese Emperor Khang-hi, an improver several thousand years ago, who selected and sowed in his garden, and afterwards "introduced" to China, the only kind of rice which will grow north of the Great Wall.

It is useful to know that the several varieties of cereals, with their infinite differences of character, are not produced, as might be imagined, by the influence of diverse soils and climates, but by the prodigality of nature. It is doubtful whether climate,

per se, can occasion any variation, except in size and vigour; but among the host of varieties always produced, some will suit one climate, some another. Some plants are possessed of great variability of character; others have greater fixity, and are less disposed to adapt themselves to new conditions of growth. That which applies broadly to cultivated plants in general, applies also to each species, more or less. Each variety of every species of cereal has its individual traits which adapt it for culture in certain localities, varying in soil and climate and the method of cultivating, to which the prescience and experience of agriculturists will confine it.

In 1853 my curiosity was excited by a sort of wheat with wiry straw, which is grown on a patch of land in Sussex, the rich diluvium of the coast between Portslade and Arundel. In this district the crops of straw are heavy, and are apt to become laid, and the insignificant Peaked-ear still holds its own, on account of the toughness of the straw. It bends before the storm without breaking, and, remaining uninjured, it is enabled to lift itself again, so that the filling of the ear can be completed when other wheat in the same predicament would be ruined.

Some improvements, therefore, are relative rather than absolute. Italian rye-grass may be altered in habit, like many another plant, so as to become actually more productive and valuable wherever it may be grown; but the customary improvements of more difficult subjects, such as cereals, are generally relative to soil and climate, and consist in a skilful adaptation of the right variety to the right position. I could mention a robust, coarse kind of wheat, which a small farmer told me had put 50*l.* into his pocket since its introduction many years ago. He spoke, however, of fine seasons and a poor soil, and the same kind of wheat under other circumstances has been described as the worst in the world.

I have received from many correspondents interesting reports of the varieties of wheat. It is evident there is no such thing as a national variety of the bread-corn of England. In reading the reports I have referred to, one comes to the conclusion that instead of one best sort, there are a dozen varieties which may each claim the highest position in its own particular locality. As the favourites of particular growers, their merits may seem indisputable, but they are in fact entirely relative and dependent on soil and season. In the neighbourhood of Hitchin, and in similar districts, where superior sorts prevail, the two white varieties, Improved Uxbridge and Hardcastle, are esteemed, with Nursery for quality, Golden Drop and Browick for quantity. Mr. James Long, of Henlow, Beds, a selector of Hardcastle wheat, claims for it an exemption from mildew. The

Improved Square-head wheat travels far, and has largely taken the place of older favourites throughout a wide district.

In the fine corn-growing district near Saffron Walden, Essex, the best sorts of cereals are Scholey's Square-head wheat, and Pain's Rivett for autumn sowing, and Nursery for sowing in spring. The Chevalier is the best barley, and the White Tartarian the best oat. The Chidham wheat, a superfine white variety, succeeds in Surrey, on chalks and sandy loams. The Peaked-ear wheat, a sort with slender tough straw, which lifts itself after becoming laid, suits the rich diluvial soil of the Sussex coast from Worthing to Bognor, and is rarely met with beyond its special district. As a rule, foreign sorts of wheat have not done well in England; and we do not owe a single good variety to any of our neighbours. As might have been expected, Mr. Shirreff found on trial that most kinds of wheat from the colonies proved to be identical with our native varieties.

Mr. William Trumper, Lake End House, Windsor, recommends Trump wheat, Chevalier barley, and Tartar oats. He adds:—

"The late Mr. William Trumper, of Dorney, noticed some extraordinary ears of wheat in a field near the Thames, which he picked and grew the seed for several years till he had enough to sell. It has been very popular ever since, which has been about sixty years. It was at first called 'Trumper's wheat,' afterwards shortly 'Trump wheat.'"

Mr. T. Bowick, Bedford, writes:—

"The Red wheats are very generally cultivated on our clays, and are the most productive. The Browick, the Golden Drop, the Hardcastle, Talavera, are in good repute. Among the bearded kinds, Rivetts and April wheats are fairly productive. The Chevalier barley is more productive and more grown than any other kind. The varieties of oats are numerous, but they are not much grown. The White and Black Tartarian have a considerable fame."

From the Agricultural College at Downton, Salisbury, we learn that the approved varieties of that district are Square-head, Lammas, Nursery, Talavera, Browick; Black Tartarian oats, and barley from Scotland and Norfolk.

Messrs. Raynbird and Co., of Basingstoke, Hants, enumerate the following varieties of cereals:—Wheat: Red Lammas, Red Nursery, Red Browick, Golden Drop, White Trump, Rough Chaff, Hunter's White, and April Bearded Red. Barley: Chevalier, Golden Melon, Archer's Stiff Straw, Golden Beardless, and Winter. Oats: Black Tartar, White Tartar, Waterloo, White Poland, and Winter.

In the favoured district of Evesham, Mr. A. H. Savory, Aldington Manor, mentions as favourite sorts, Square-head, Browick, Golden Drop, and Rivett Wheat; and Hallett's Pedi-

gree and Awnless barley. The following answers to my questions apply to the peat soils of the Isle of Ely:—

"Of all the numerous varieties of wheat the two best, taking into account all seasons, are the 'Essex White' and 'Red Nursery.' The latter has proved of specially good quality on the poorest soils, when all other kinds have been blighted; but the yield is generally one or two sacks per acre below the Essex White.

"The first kind was introduced by Mr. Marriage, living near Chelmsford, and was grown from a single fine ear selected by him. The Nursery is a very old variety, grown in Essex for the last forty years; it can be sown as a spring wheat. I once sowed a field of it in the middle of March and reaped it on the 12th of August."

Mr. C. S. Dods, Haddington, recommends Hopetoun, Fenton, Trump, and Square-head wheat; Chevalier barley, and Hopetoun, Potato, and Sandy oats. At Selby, Yorkshire, the best varieties are Hardcastle, white; and among red wheats, Browick, Square-head, and Creeping wheat; Chevalier, Awnless, and Giant barley; the two last-named from Messrs. Raynbird and Co.; and Tartarian, Friesland, and Black and White Enfield oats.

Mr. A. S. Wilson, Aberdeenshire, says—

"There is considerable effort made by most farmers in this district to get better varieties, or rather, purer samples, for seed. The exhibits at the various seed shows are sold by auction and generally fetch very high prices. Erroneous views prevail as to weight per bushel being a test of excellence, and a few years ago Canadian oats, which sometimes weigh 50 lbs., were extensively used; but as they have the lowest percentage of kernel of all the cultivated varieties, they are going out of fashion."

At Aspatria, Cumberland, many varieties of wheat are grown to suit the changeable soil. The best are Creeping White, Norfolk Prize, Yellow Chaff, Farmer's Friend, Red with White Chaff.

At Bonnington, N. B., the varieties are thus placed in the order of merit: *Wheat*:—1. Square Headed; 2. Fenton; 3. Hunter's, Blood Red, Browick, Spalding, Red Chaff, Velvet, and other English white sorts.

The few examples of varying character quoted from Mr. Shirreff's experience would suffice to show that the production of a best variety for all districts is contrary to the true principles of improvement. If the increase of the productive powers of a plant were a process of arithmetic, or a mechanical operation, like adding an inch to the rim of a bushel, the improver's work would be easy. But a plant has life regulated by law; and, having life, it is endowed with constitutional temperament, and the crop must depend on contingencies almost as numerous as those which affect the physical well-being of man himself. The plant-improver learns what is needful in different neighbour-

hoods. "We want a wheat," says a northern farmer, "which will ripen three weeks earlier than any of our varieties." Diseases have been prevalent in the late unhealthy seasons, and we are asked for varieties which may defy them. It is not a matter of hypothesis, but a fact of observation, that some wheats are less liable to rust than others, and that this arises from their origin or their constitution, some varieties enjoying in this respect an immunity more or less complete. Wheat, again, may become laid from several causes, physical or chemical, and these may operate alone or in concert. Storms and high manuring are beyond the influence of the wheat-breeder, but it is his business to consider temperament. Some varieties of wheat have a heavy ear, as well as straw which is at once weak and loaded with leaf, so that the crop must needs fall; and coarse-strawed wheat often falls flat and all together.

Whatever the American cultivator may have done to secure the divergence of maize, and to adapt it to different soils and localities, the English improver may do in the case of wheat. It would be an error to suppose that nature helped the American, for, if progress be a law of nature, retrogression and degeneration are quite as much so. Nature shows no solicitude as regards cultivated plants, and her selections, securing the survival of the fittest, would not be favourable to a high-bred, high-fed cereal. The plant-improver, on the contrary, is not impartial, he derives the principle of selection from nature; but in carrying it into practice he works systematically and thoroughly with one object—the improvement of the plant from his point of view. We have seen what Mr. Shirreff effected by means of his accidental discoveries, and the question naturally arises whether artificial crossing and the "matching" of suitable varieties will not effect greater improvements than the accidental operations of nature. At present the cross-fertilisation of cereals, and the subsequent selection of the varieties, has been but slightly attended to, and we must wait for results.

Mr. Laxton is one of the ablest hybridisers and improvers of horticultural plants, and cannot spare time for other breeding; but he writes that he did once cross wheat, working upon the Early Japan variety, and the most productive sorts of high quality. The results of such calculated labours should exceed those of all haphazard crossing, whether natural or artificial. The experimenter should commence his operations with a clear knowledge of the task he has set himself, and of what particular modification he wishes to accomplish, whether he wants a hardier variety of the plant he is engaged upon, an earlier or a later sort, &c. Dr. Masters, as Editor of the 'Gardeners' Chronicle,' has had a long and intimate acquaintance with the

wonderful feats performed by breeders in the department of horticulture. He writes—

> "Gardeners, as you know, cross very largely all sorts of things, but they have to do it on a very large scale and to exercise undaunted patience, because they draw so many blanks and so few prizes. *But* it is a curious fact that while the first generation is often a mass of worthless mongrels, some of those mongrels, if grown on, eventually develop into something good."

We have seen that Mr. Shirreff's crossed varieties of wheat scarcely answered his expectations; but he was a breeder for a period so short, that even failure under such circumstances need not deter others, since all the triumphs of plant-improvement have been due to the crossing of varieties and to selection. It was by these processes, as we have seen, that maize has been spread over such extended districts; and varieties of wheat of improved sorts, each suited to its district, will reward those who patiently attend to this branch of cultivation. The principles of plant-improvement, however, must be mastered by those who would practice the art.

A selector of wheat has maintained, correctly enough no doubt, that every ear contains one grain more productive than the rest; but in carrying out the principle of selection he sowed his best seeds at wide intervals. This kind of seeding means high feeding, and produces large coarse grain and stout weak straw. It induces, therefore, constitutional defects, with probably a predisposition to blight and mildew, and the other diseases to which enfeebled plants are specially liable. In well-farmed fields the best seeds select themselves, since their produce is greater than that of others, and therefore every year a larger proportion of the most productive seed must be sown. It is sown, too, on clean land, sufficiently but not too heavily manured, under conditions most favourable to the health of the plant. No doubt the art of plant-improvement consists in the selection of good qualities and of profitable modifications; but when the improver introduces another principle, that of high feeding by thin sowing, he alters the plant by a totally different method from that employed by the selector. As a general rule, the improver should aim to produce varieties yielding grain of superior quality. A coarse and vigorous variety may be excellent for poor soils, but when the thin seeding is carried so far as to render the grain unusually large and light, there is then danger of disaster through impaired vitality and constitutional vigour. A habit of excessive tillering is induced by early and thin seeding, and wheat which had acquired that habit has been known to continue tillering in the summer—having been sown in the spring—and to be still spreading over the ground a grassy mat of herbage, when other varieties, sown at the same time, were in ear.

I have probably named some of the best sorts of cereals in various districts, but plant-improvers are generally of opinion that the best sorts degenerate. This, however, is a moot point, and the so-called degeneration often means only want of care or soil-exhaustion. On the other hand the last century had its "best sorts" like the present; and Mr. Carruthers can show seven boxes of samples of wheat collected by Sir Joseph Banks early in this century, each labelled with its name; and probably nine-tenths of these varieties are now quite unknown to the farmers in the districts where they were then cultivated.

Professor Brown, of the Ontario Agricultural College, gives the following example of the degeneracy of a famous Canadian variety of wheat:—

"I have been offered again and again, by our millers and our Government, all the money that any one need desire, to bring back the old *Red Fife* (we don't use the distinction '*Red*' here), the best spring wheat that Canada ever had. It has, however, left us, what owing to is not clear. Neither in yield nor sample can we grow the good old Fife. We find a decided improvement in its production on the *new lands of Manitoba.* Seed from here to there comes back after three years much better filled, better in colour, and more even in size of berries, but yet not the good old Fife of Ontario."

The progress of degeneracy is prevented by taking care of old sorts or the introduction of new ones, and improvers therefore may rely on the permanent character of their vocation.

Peas, Beans, "Roots," Potatoes, and Forage Plants.—I do not propose writing an essay on each of these plants. My readers are aware that peas in gardens have been greatly improved since the original modifications effected by Thomas Andrew Knight as the result of skilful crossing. Some of my correspondents are trying the improved garden peas for field culture. It has certainly become desirable in many districts to cultivate varieties for marketing, instead of continuing the growth of the old grey and maple peas. By sowing the improved sorts, a crop may be obtained which will perhaps be valuable for picking and marketing when green, and, on the other hand, if it should not be in demand for that purpose, the produce would still be worth several shillings per quarter more than the old sorts of peas, such as maple and early duns. Both growers and seedsmen, and the hybridisers, who are at this time giving great attention to peas, are doing so with a view to the double object I have mentioned.

A correspondent writes of beans from an eastern county—

"The winter bean introduced into this district by me at least forty years ago is the most certain in regard to yield, exhausts the land less, and is less particular as to soil than any other variety. By selection it has become lighter in colour and the seeds larger."

Beans are a favourite and productive crop in the Isle of Ely and the fens, and probably some of those enormous pods that ornament the seedsmen's stalls at the Agricultural Shows are pampered in that district. I have not much faith in the stamina of giants, or of monster ears and pods. Suits in courts of law occasionally remind us of the folly of sowing the seeds of abnormal plants, and of the credulity displayed by some farmers. But an experienced correspondent in the fenland reports great improvement in beans. A sort called the White-eyed Chatteris is much sought after, having been for years carefully selected in that parish by hand-picking. The crop may be distinguished blindfold for its stout vigorous habit. The Double-blossom bean and the Cluster bean are also favourites in the same district, and the large Windsor bean is much grown in the same bean-producing country; notably an improved and very prolific large-sized variety, which often produces as many as ten or twelve stalks from a single seed. In other districts the Scotch bean, Winter bean, Horse bean, and Tick are in good repute, and the early and productive Mocha and Mazagan for spring sowing.

The varieties of the several kinds of "roots" are far too numerous to be named. Those which are sent out by the prominent firms of seedsmen are generally good. Mr. A. S. Wilson says of turnips:—

> "Every seedsman says he has greatly improved his stock. Pliny tells us that the old Romans raised turnips 40 Roman pounds in weight (12-oz. lbs.). And Dr. Skene Keith, who wrote an agricultural history of this country at the beginning of this century, found bulbs up to 38 lb. weight. The processes of improvement and evolution are too slow for the patience of most experimenters."

There is much truth in this last observation, which is applicable to every kind of professed plant-improvement. Still, it will generally be acknowledged that the competition of seedsmen in this department has not been in vain, and if the swede is a hybrid, as most botanists believe it to be, the improver can claim it as a very profitable modification. My correspondents generally report improvements. The great number of the varieties of swedes and turnips, and the difference of the sorts in different districts, prove that their qualities vary, and that some are adapted for one climate some for another. The seed of a tough-leaved cabbage is largely grown in this country for the American farmers, who find that this particular sort succeeds best in their hot climate. Similar constitutional differences adapt the varieties of turnip to different districts. The names, perhaps, should be sought in the seedsmens' lists, and I shall only mention a few characteristic types. Mr. Melvin, of Bon-

nington, N.B., says that turnips have been very much improved by the crossing of different varieties, and he names among improved sorts Fostertoun and Dale's hybrid swedes, which are full croppers, but not the most hardy, the quickest in growth being the most rapid in decay. The Green-top swede and Aberdeen Green-top Yellow turnip keep better than others, and stand frost better. The varieties of Skirving's swede and yellow turnip are intermediate.

In some districts in the north a special reason is given why Skirving's purple-top yellow, which was a great favourite twenty-five years ago, is hardly ever grown now. This is its liability to mildew. Fostertoun hybrids are much more free in growth than the other yellows, but they should be used before the New Year. Purple-top swedes are the main crop; next to them in importance are Fostertoun Hybrid Yellow, then Aberdeen Green-top Yellow. White turnips are not much grown, except an acre or two for early use, or when swedes fail and the sowing is late. Swedes are usually sown from the 10th to the 25th of May, Fostertoun's until the end of June, and, as a rule, Aberdeen Yellows are not sown after about June 10. I need not say that stubble-turnips are not sown in the north. Fostertoun Hybrid is greatly approved in Cumberland as a free-growing turnip, which produces a great crop, and feeds sheep and cattle well. One cannot always give even the name of the introducer of an improved sort, still less relate the history of his patience and skill in its cultivation. The Fostertoun improvements, however, were first introduced by Mr. Robert Hutchison, of Fostertoun, Fifeshire.

The Bangholm swede is in much request in some districts in the north of England where cabbages are not grown.

The best farmers in the seed-growing and other districts in Essex, Beds, and other counties, are of opinion that no farm-crops have been improved more than root-crops, and that seedsmen have done good service in raising fine strains which produce heavier crops than those formerly grown. The following sorts are spoken of with favour:—Pomeranian White Globe turnip, for early folding; Green Round turnip, and Aberdeen Yellow Bullock, which has little tendency to run to green in spring; the Tankard swedes, for pitting till lambing-time, and several other swedes.

Among other turnips of the southern districts are White Globe, Grey Stone, Green Round and Red Round and Tankard turnips, and Purple-top and White swedes. The Pomeranian turnips were formerly the best for early folding. On light land in Surrey we usually commenced folding this turnip by September 1, when the crop of roots and leaves together was a

heavy one. In examining a large number of plots of different sorts of turnips in the trial-grounds of an eminent firm of seedsmen in August, the Pomeranian was found among the early sorts; and if it be true that other varieties now surpass it, yielding a heavier crop in a shorter period, with the same treatment, the fact can easily be ascertained by the method of comparative trial which, in these days of new varieties and eager competition, should be resorted to by all who would obtain the best sorts for their particular localities.

The process of comparison would supply information which no amount of advice from counsellors residing off the farm, or from observation of crops in other districts could afford. With regard to the methods of improving turnips, cross-breeding has been and is constantly effected by the various amateurs and other breeders who turn their attention to such operations, and the results of whose labours are generally brought before the public by seedsmen. But selection is constantly necessary to maintain the purity of the breed and the original standard of its form, colour, and quality. Those who are engaged as growers for the seedsmen continually select, and the work is usually inspected during its progress by the seedsman himself or his representatives. One of the greatest of the seedsmen replies to one of my questions that turnips, mangolds, and cabbages have been improved "by constant selection and by re-selection, and the production of stock-seed for the purposes of re-production, at infinite trouble, and frequently great outlay." This is no exaggeration, and the system of competition, though it may lead occasionally to the introduction of novelties without merit, will continue to secure a high degree of excellence, as well as the continued improvement of the plants of the farm. Farmers may grow turnip-seeds for themselves, and that would be far better, if it be done with proper care and attention, than purchasing inferior seed from indifferent seedsmen. Or farmers may conduct the business of seed-growing in co-operation, employing an expert to superintend the concern, to select the roots or grain, and to conduct the experiments in breeding. But the business must be well managed if a successful competition with the leading firms of seedsmen is to be effected.

I think it will hardly be disputed that mangolds as well as cabbages have been steadily improving. A great change is perceptible in the earliness, size, and quality of cabbages grown by market gardeners, and these improvements and the introduction of the thousand-headed variety have led to the extended growth of cabbages in agriculture. The introduction into some districts of the Drumhead-cabbage, improved by Mr. Robinson, and of various early varieties, has been exceedingly advantageous.

The same principles apply in the breeding of plants and animals. Cross-breeding is a method of introducing new characters, and selection of modifications is a method of moulding according to taste or fancy. The more the former practice is resorted to, the greater the diversities among the offspring, and therefore the greater the need for selection. As an example among roots I may mention the Golden Tankard mangold, a superior variety, which cattle will fight over when it is put in the trough with other kinds. It is yellow in flesh with yellow leaf-stalks, and it requires constant selection on account of its mixed breed, being a cross between a yellow and a red mangold, and inclined to reproduce the characteristics of the original parents—the red marks of one, or the yellow skin and white flesh of the other.

It is possible that some of my informants may be a little too partial to particular varieties, nevertheless a few extracts from their obliging communications will show that improvements have been attempted and accomplished, unless a great number of the most practical authorities are deceived. An experienced informant, Mr. John Fryer, of Chatteris, says of mangolds in the fens—

> "Mangolds are also largely grown. By far the most valuable as regards quality of root, amount of saccharine, &c., is the 'Golden Tankard,' first introduced by Messrs. Sutton and Sons. Any kind of cattle, horses, or pigs will pick these out to eat first amongst any other sort. I have known them to retain their sweetness up to August, when other kinds were acrid or tasteless, and *pithy* or dry. The yield per acre is not quite so great as the long 'Mammoth Red,' or perhaps the 'Yellow Intermediate,' but I have grown 50 to 60 tons per acre, which I should prefer for use to 60 or 70 tons of any other kind."

Other seedsmen possess other sorts as good perhaps. One correspondent recommends the above-named sort of mangold for sheep, and another sort, the Mammoth Long Red, for cows. There may be some force in such a distinction, but the main point must be that a mangold should store well.

"Thirty-five years ago," says a successful selector, "I assisted in the improvement of a globe mangold for Mr. Brandreth Gibbs, of Half Moon Street, Piccadilly;" and this sort, he says, had a skin as tender as an apple, and a single tap-root so free from the clinging fangs of coarse mangold, that the crop was easily lifted, in fact you could walk down between the rows and turn the roots out of the ground by giving them a kick right and left. More than twenty years ago the same grower was engaged in the improvement of mangolds for one of our most active firms.

He has also devoted much attention to the carrot, which has been a valuable crop in his district since the introduction of a sort which has sold well in the London market, and which yields

a greater weight per acre, and has longer roots than the older sorts. The white Belgian carrot yields the largest crop of any field sort, but the quality falls short. A seedsman claims to have produced a carrot which answers well on shallow soils; and another has a "splendid variety, long, even, bulky, and of excellent feeding qualities. When tender and not grown to its full size, it is as good as any garden variety."

The root-crops, like others, must be adapted to soil and climate.

The potato is essentially a constant subject for the plant-improver. Mr. Darwin shows, in 'Animals and Plants under Domestication,' that the tubers have been greatly enlarged and improved since the introduction of the plant. The potato-disease brought into constant operation the principle that increased vigour is imparted by the crossing of varieties. Hence the vast number of varieties in cultivation. Mr. Robert Fenn, of Sulhampstead, Reading, has spent forty-five years in breeding potatoes of excellent quality, and generally of the early kinds. Among the descriptions he has sent me, one relates to a "very desirable variety, which is off the ground sufficiently early to grow turnips afterwards, to be fed off by sheep, and then sown with wheat, or winter vetches, or other crops." There is another variety which, he says, would suit Ireland well, as it does its duty quickly, and would be, if the growers would "buckle to," out of the way of their autumn rains, and would escape the disease. In describing his method, Mr. Fenn says, "I spent ten years during my earlier experiments in trying to raise superior varieties by seed from promiscuous berries, and never met with the least success," Magnum Bonum, raised by Mr. James Clarke, of Christchurch, Hants, being the only example of a fine variety raised by sowing seed at random. All experience shows that the principles of plant-improvement require careful study. Mr. Fenn had spent ten years previously in the vain endeavour to improve the types of varieties by careful selection of the best forms of tubers, and he now knows that selection has not yet produced any new or really improved form of potato. The ash-leafed kidney sometimes develops *lumps*, which give it an appearance widely different from that of the true stock, but the lumpy ash-leaf nevertheless reproduces the true type. Selection has given us many very valuable and entirely distinct new forms of mangolds, turnips, or carrots; but potatoes cannot be moved from their original shape by selection, so that new and improved sorts can only be had by cross-fertilisation. I believe the sole exception to this rule consists in a selected sport from the Rector of Woodstock.

The following details by Mr. Fenn contain useful hints for

improvers:—"It has taken me forty-five years to arrive at what I have done with the potato; and the variety does not now exist with which I could cross any of my latest seedlings to improve them, taking quality as a prime test; because for twenty years past I have been crossing and re-crossing continually all our best old English varieties, handing down, so to speak, their flesh and blood, and now, after having crossed them with the best of the American breeds, I am at the end of my tether. I could go on crossing to get size, but that would mean deterioration; and I could go on breeding 'in and in' with my own best sorts, and I well know what would happen." Crossing with recent varieties raised by others would, he fears, lead to deterioration of quality, so he leaves others to solve the problem of further improving potatoes.

Improved forms of forage-plants or roots are far easier to produce than improved seed-bearing plants like cereals, and the rye-grasses offer a variety of forms capable of advantageous modification. In the trial-grounds at Reading there were numerous plots of rye-grass, good and bad in character, as well as examples of the same variety of rye-grass differing in quality in consequence of the seed having been produced in different districts. The common annual and the perennial rye-grass differ greatly in luxuriance of growth, the best sort of perennial rye grass being exceedingly productive and worthy of its position, as a grass that forms one-third of the bulk of some of our most productive pastures, while the annual variety is as unproductive as it is unpromising in appearance. One of these grasses, in the middle of July looked brown and poor of produce, while the other was green, and growing like a plant which must needs produce a bulky crop. Among all the adulterations by which unwary farmers have been defrauded, none are more readily effected, none are more frequent, than those by which unscrupulous traders obtain undue profit in the sale of rye-grass which is not perennial, though it is represented as being so. The improvement of this particular crop urgently requires that the seed should be tested, that it should weigh from 20 lbs. to 28 lbs. per bushel, that cheap seed should be avoided, or sown side by side with other seed supplied by seedsmen of repute. The tendency of Italian rye-grass to produce seed-stalks instead of leaves, a characteristic fault which heavy and early stocking partially removes, has long presented itself to the notice of plant-improvers as one which perhaps might be removed. A selector having succeeded in producing what is called a Giant Evergreen Italian rye-grass, remarkable for its early growth of spreading leaves, the eminent firm who obtained the stock have been able to add to this most useful class of forage plants a

decided improvement. A large farmer in the fens took me over his fields of this new kind of Italian rye-grass early in August. The whole of it had been cut for seed, and the shocks were still standing in the field waiting for fine weather, while a thick aftermath of spreading leaves already covered the surface. In this growth of a good bottom grass it resembles the old Pacey varieties. It is said that the growth of lucerne is extending, and that that plant was always grown in the fens; but my friend, who is experienced and by no means over-sanguine, believes that the new Italian rye-grass, with the only fault of that famous forage plant removed, will drive it from the field.

The same gentleman once observed in one of his fields of Italian rye-grass a "sport" which grew with its stems branching from the ground, but on sowing the seed the peculiarity was unfortunately not reproduced. He is, however, a firm believer in the value of the novelty I have just described, of which I will only say further what a correspondent says of cow-grass, and which in fact may be said of anything promising which persons of repute may advertise, that it is worth a trial, that is, a comparative and competitive trial. "Farmers," says a valued correspondent, himself a tenant farmer, "do not enough compare different varieties under identical circumstances."

The importance of forage plants for folding, soiling, or for hay has increased, and the seedsmen are engaged in their improvement, and have already made a good beginning. About thirty-five years ago *Trifolium incarnatum* was grown in Surrey by my father and others, who welcomed it as a useful forage for sheep and horses, with one fault,—it remained in perfection only about a fortnight from the opening of the blossom to the hardening of the seed. As it was a garden plant grown for the beauty of its crimson flowers, and as almost anything can be done by practised horticulturists in the modification of plants, later varieties, or sub-varieties of trifolium have been forthcoming, and those who farm within the limits suited to this crop, extending perhaps fifty miles north of the Thames, or further on warm soils, or in favoured spots, may have the use of trifolium during about six weeks. A sheep farmer on the deep diluvial soil of the coast of Sussex, near Worthing, where the plant grows in perfection, informs me that he now has it during six weeks. On the 16th of June this year, Messrs. Sutton showed me four samples of trifolium grown in their trial-grounds, under precisely similar circumstances, of which the earliest crimson was out of blossom at that date and the heads hard with seed; while two other sorts, crimson and white, were twelve or fourteen days later, the

blossom being nearly full and the plants in perfection for feeding. The fourth sort was the latest crimson, which scarcely showed any blossoms at that date, and was ten days later than the other late sorts.

These are most important modifications of a forage-plant, and they would lead one to conclude that red clover may perhaps be rendered more useful by similar changes of habit, and the persistent selection of the earlier and later plants, which in any field of clover may be discovered. Messrs. Sutton's trial-grounds this year contained some exceedingly interesting plots of red clover, conveying valuable lessons on the effects of climate and on the varying periods of maturity. In the case of red clover grown from English seed side by side with that from German seed, the former was far more vigorous, and a more bulky crop than the latter; and the German was later. But a much stronger caution to beware of foreign seed was given by the plots of red clover from American and French seed. Canadian seed produces stout robust crops, and that from the North of France yields crops of pretty good constitution, but the red clover imported from the South of France, is quite unsuited to our climate. It either perishes in winter, or, like that from the United States, its growth is weak and sickly. In matters of this kind no sort of instruction equals that which is conveyed by the eye, and I hope that competitive trials will lead to the disuse of inferior foreign clover-seed, a large quantity of which is at present sold and sown in this country.

The earlier and later "habit" of English and German clover, or of Indian and English wheat, or of maize, or other corn which ripens at different dates in different localities, suggests that perhaps red clover might assume earlier or later forms, like trifolium. A correspondent who is not acquainted with the two distinct forms known as cow-grass (not the *T. medium* of botanists) and red clover, says:

> "It is just called red clover whether it is grown from English, German, French, American, or Canadian seed. The last-named seed is growing in favour so, that seedsmen now offer it as Canadian. All through the spring and winter clover grown from Canadian seed retains a rather shy habit; but when warm weather comes, it rushes out, and is soon equal to English. It is not quite so tall, perhaps, but yields as heavy a crop, owing to the plants branching more freely."

These are marked characteristics. The habit of "rushing" in their growth, as most plants do in the forcing climate of an American spring, may not be permanent, perhaps, but so long as it lasts it is advantageous.

Why should not agriculturists effect with root and forage crops what horticulturists have accomplished in another depart-

ment of culture? It is, I think, quite to the purpose that I should mention the lettuce, the old sorts of which were available for two or three weeks only, except when sown in succession. The new sorts of lettuce, such as Commodore Nutt, a very early kind, Superb White Cos, Marvel, or Standard, the latest of all, have been endowed with a habit of early or late maturity, so that a good succession of lettuces can be secured at a single sowing of these kinds. Instead of lasting for two or three weeks, they are fit for use during two or three months. Not even the able Botanist of the Society could trace the cause of these changes of habit, or discover with the microscope their accompanying morphological effects.

A practical plant-improver would at once recognise that what has happened to the lettuce may happen to red clover. The majority of farmers are still unaware that an earlier and later red clover already exist. I have received various interesting reports on this subject. According to an excellent practical authority, cow-grass is a name given to different plants in different districts. At Mark Lane it simply means a fine sample of common broad clover, whereas in Berks, Oxon, Hants, and a few other counties, it means a perennial variety giving only one cutting per annum, coming into bloom a fortnight after other red clover, and having a solid instead of a hollow stem.

Mr. Robert Russell, of Horton Court Lodge, Dartford, writes to me of three red clovers: the Common; Cow-clover, which yields three cuts per annum; and Cow-grass, which yields one heavy cut, will stand two years, and has almost gone out of cultivation owing to the cost of saving the seed and threshing it. On June 24, he writes: "I have 20 acres of the single cut cow-grass which will not be in bloom for a fortnight. It will be fit to cut for hay in a month; the red clover is fit to cut now."

Other evidence has reached me to the same effect as the above, and in addition to it I add the following notes of my own, taken June 19, while examining single-cut cow-grass and red clover grown side by side: "The cow-grass is two inches taller than the red clover, and later. Its blossom-heads are still green and immature, while the rose-coloured blossoms of the red clover are already open. The stems are smoother, though some of the leaves are covered with fine hairs, as in the case of the red clover. The stems are longer, and generally hollow—some of them are solid. The stems of the red clover also are generally hollow. Each variety has green and purple stalks indiscriminately."

Mr. H. E. Raynbird says the cow-grass blossoms two or three weeks later than red clover, and the distinction between them is as well known as that between barley and oats. Mr.

Martin J. Sutton states that cow-grass used for soiling rarely gives more than one crop a year, with a bite sometimes in autumn. It comes into cutting three or four weeks after red clover, and remains in good condition two or three weeks. It stands several years. Mr. Sutton recognises that the alleged peculiarities of stem and leaf are not persistent; but he says the stem is generally solid and smooth, the land, however, making a great difference in regard to these peculiarities. Some samples of the seed are more like red clover-seed than others, and a pure sample will sometimes vegetate as though it were mixed. He finds it a "whimsical" plant in some respects, but, always true to its leading and valuable features, as a clover adapted for poorer land than red clover, and yielding later forage.

Cow-grass, I have myself observed, tillers very freely when planted thinly, and a single root may carry under such circumstances thirteen stems, which then assume the trailing habit of zigzag clover, the cow-grass of botanists (*T. medium*). As red clover is one of the most important plants in our agriculture, and one of the most profitable when it can be obtained, other reports by practical agriculturists may perhaps be read with interest. Mr. J. P. Franklin, Britwell, Oxon, finds that single-cut cow-grass yields more seed per acre than red clover, so that the cost of growing the seed is due to the sacrifice of the whole year's produce of the land, and to the expense of threshing a bulky crop. He has favoured me with the following remarks:—

"I grew 5 cwt. per acre in '78; and in that year, which I think we shall never forget, '79, ½ cwt.; both sold at 1s. per lb. On an average you may expect 3 cwt.

"I have grown it a second year for seed with success, and have one of the finest crops of White Tartar oats I ever saw on a very poor hill after it.

"If mown for hay I believe it would stand a number of years, but would require cutting when coming into bloom, or the hay would be very coarse. It is first-rate green-meat for horses, or will take a lot of ewes or sheep often when the after-feed of the red clover is not ready.

"It comes into flower about three weeks after red, and is a good preparation for wheat. I have planted it now about twenty-five years, and was one of the first here to save the seed."

Mr. T. P. Hatt, Ipsden, Oxon, wrote on June 27, when the single-cut cow-grass was just budding for bloom, and the broad clover very nearly in full bloom. The former he says produces a very large crop on good land. He has had it so luxuriant in growth as to measure five feet long, but it then exhausts itself in one season, and does not answer for a second year.

"On the thin chalk, where red clover is of very uncertain growth, it grows two years, and makes good hay. It is invaluable for green food for horses, but should not be cut for them till it begins to blow. Every farmer who farms arable land and has to keep his horses in the yards or stables all the summer should plant about 1 acre to every 100 annually. I always sow the S. C.

cow-grass by itself. It is quite as good a preparation for wheat as the common red clover, and grows with a similar tap root. I generally sow 2 lb. more seed per acre than in the case of red clover, as the seed is rather larger than that of broad clover as a rule. It has been grown in this neighbourhood over twenty years.

"Unlike broad clover, after you have cut it for hay you cannot seed it, but it grows sufficient to fold the sheep with. I am doubtful whether it would stand a second year after being saved for seed. Two or three farmers in the neighbourhood generally save some for seed."

To these practical reports I am able to add the following by Dr. Masters, F.R.S., to whom I had forwarded specimens of red clover, "single-cut cow-grass," and *T. medium*:—*

"Sutton's 'single-cut cow-grass' is to my mind only a variety of our common red, or broad-leaved clover, and is, I presume, a 'selection' from it; but its marked tufted habit and late development are, I should think, good qualities under certain cases.

"I should have thought that 'single cut' might have been replaced by 'cut-and-come-again,' provided the first cut were made early enough; but I suppose experience shows the latter-math to be of little value.

"As to the perennial character, I fancy that might be enhanced by early cutting, before the flower-heads are well advanced. The cutting or browsing (if done early enough) would have a tendency to cause the stock to branch out and form new crowns; of the practical advantage of this you would judge. I only speak from a physiologist's point of view.

"The stems are apt to be hollow below and filled with pith above, because the rate of growth is faster outside than in; the consequence is, that in the older portions of the stem the outside draws away from the centre, leaving the latter void. The amount of 'hollowness' varies a good deal, even in stems from the same crown, according to stage of growth. Nevertheless, I fancy 'Sutton's single cut' is the less hollow of the two; and if it is of slower, later growth, that is just what might be expected.

"*T. medium* is widely different. The root is very distinct, and the whole habit of growth such as to make it less serviceable, other things being equal, than the common clover.

"The specimens afford a practical illustration of the meaning to be attached to the word 'species.' No one can say definitely what a species is, or indeed whether it is not a convenient figment of the imagination; but we are able to form a good working notion by observation and comparison. For instance, I should say your English red clover and the single cut are one and the same species, in spite of their differences, because I should readily believe that they might have sprung from the same original stock within a relatively short time. *T. medium* is so different, that I should not believe (till it was proved) that it sprung from the same stock as the others, at least within the historic period! At the same time the difference is not too great to forbid my entertaining a reasonable conviction that, given geologic time, the 'medium' might have sprung from the same stock as the two others. If it be of hybrid origin, however, then the process would be much quicker."

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* I think it necessary to mention here, in support of some preceding quotations from practical farmers, that the opinion of this eminent botanist, although entitled to the greatest respect from a botanical point of view, does not accord with the received estimate of the *agricultural* difference between "cow-grass" and "red clover." That difference may be thus stated: "cow-grass" has a solid stem, "red clover" has a hollow stem.—Edit.

Dr. Masters adds :—

"I understand that what is wanted in a clover is a deep fleshy-rooted perennial variety capable of spreading far and wide below ground, and thus of collecting and storing food from a large area, with a tendency to branch at the crown (to tiller, I should say, were it wheat), and I do not suppose there would be much difficulty in selecting and improving such a variety."

Linnæus thought the Alsike clover was a hybrid, and it certainly looks like a cross between *T. repens* and *T. pratense.* If it be so, improvers may find in this robust and useful plant an example of the results of hybridising clover. At present I believe neither hybridising nor crossing has been attempted in the case of the clover tribe, nor has any improver apparently made it his special task to search the fields for natural crosses, which has been so largely done in the case of wheat, nor even to practise the methods which Dr. Masters recommends for the improvement of the plant. There are many distinct peculiarities in the foliage and habit of red clover grown in different countries and localities, which improvers may avail themselves of. M. Henry Vilmorin mentions two kinds of red clover in cultivation in his district, the common and the Brittany, the latter being the stronger of the two, but not quite so hardy as the other. M. Rimpau informs me that Dr. Stebler, of the Seed Trial Establishment at Zurich, states that in Switzerland the seed of the perennial red clover of the permanent pastures, called "wild clover," is preferred for sowing to that of the cultivated variety. In England this form of clover would not be considered sufficiently productive to be worth sowing in alternate husbandry, and it is not regarded as a pasture plant of the best quality.

Clover, lucerne, and other plants used for soiling may be improved for the time, and perhaps permanently altered by cutting them as early and, within bounds, as often as possible, which will check the formation of dry, fibry stem, and tend to the repeated production of succulent foliage. Weak liquid manure will assist, and potash manures should follow.

Perhaps it will not be quitting my subject to mention that the inferiority of many a field of clover arises from the purchase of low-priced foreign seed. All the seed required for home use might be grown in England, and there ought to be no demand for the cheap seed of America or some parts of France, whose wretched produce would surprise the purchasers if they would only be at the pains of making a comparison at home, or of visiting the trial-grounds of those seedsmen who would willingly afford them the opportunity of informing themselves.

During the past season, and at the same markets on the same day, the prices of red clover-seed varied from 70*s.* to 130*s.*

per cwt. Those who are so ill-advised as to purchase inferior foreign seed might be induced perhaps to save the produce for seed, increasing, though undesignedly, the inherited feebleness of a plant which needs strengthening!

With regard to hops, Mr. Whitehead, Barming House, Maidstone, informs me they are propagated entirely by cuttings, but in East Kent they sometimes raise "seedlings." * The "Golding's," Jones, Colegate's, each adapted to particular soils and sites, were originally seedlings. Though the female plant is the one cultivated, yet it generally happens that one or two male plants spring up, or a male branch on a female bine, and these suffice. As the plants are diœcious, *i.e.* have male flowers on one bine, female on another, cross-breeding to some extent *must* take place.

Change of Seed.—In all parts of the country farmers act in the belief that benefit is derived from a change of seed from one soil or district to another. A well-known grower of a pure stock of Chidham wheat, living near Guildford, used to change the seed from his farm on the chalk of the North Downs to a clay farm in another district, and the farmers of Sussex change from the Wealden to the chalk, and from the rich coast land to the interior. According to a doggerel from the fens, "Sand is change for no land." Any other change is held to be good, the change from a cooler climate, and from clay or strong gravel soil to peat, inducing a larger produce with less liability to blight. In discussing this subject, Mr. Darwin shows that "slight changes in the conditions of life are favourable to plants and animals," and the breeders of each recognise this truth. The benefits that ensue from crossing and those derived from "slight changes in the conditions of life" are analogous phenomena. "Life depending on, or consisting in, an incessant play of the most complex forces, it would appear that their action is in some way stimulated by slight changes in the circumstances to which each organism is exposed."† Judging from the reports of my correspondents, the practice of changing the seed of cereals is almost universal both in Europe and America.

M. Henry Vilmorin informs me that "in some parts of France it is a common practice, in order to secure larger and more certain crops. The change is effected generally from a colder to a warmer district, or from a poorer to a richer soil." Seed is changed, however, with several objects; and sometimes for the sake of securing earlier maturity it is brought from a

* See Mr. C. Whitehead and others on "The Hop" in 'Journal' R.A.S., and the article "Hop," in Royle's 'Materia Medica.'

† 'Animals and Plants under Domestication,' vol. ii. p. 130.

warmer soil and climate, and the produce retains its earlier habit for a few years. So far as the general principle is concerned, American evidence is as useful as English, and I may therefore quote Mr. F. H. Horsford, Charlotte, Vermont, who says what my experience confirms, with some exceptions: "It is believed by some that it is not best to go too far for seed. We think it better to go a little to the north-east or west than to the south."

This means that in obtaining change of seed we should keep within bounds. A gentleman who endeavoured to ripen maize on the banks of the Thames bought the seed at Mark Lane. It proved to be the "dent corn" of the south. He deprived himself of all chance of success by sowing a slowly maturing variety, which is habituated to a much longer summer and hotter sun than ours. M. Henry Vilmorin mentions an interesting piece of experience with regard to the change of seed. After remarking that the effect of climate in inducing a change of habit is certain, only its action is very slow, and does not effect a marked change unless it is exerted for a long series of years, he continues: "With our farmers, seed imported from a different climate is not much thought of in the first year of proof. Seed-corn is much more valued when harvested in the district from foreign seed which has been grown there once. It is thought to retain its primitive good qualities, and, besides, to be broken to the soil and climate. This is especially the case with flax-seed from Russia."

Every year losses are incurred in England and America from the injudicious sowing of fine samples of wheat from hotter climates. Australian wheat may have been originally derived from England, but the climate has changed its habit, it blossoms prematurely, and is in other respects unfitted for this country. In France it has been found impossible to grow Australian wheat, owing to its liability to rust. Several varieties of English wheat, on the contrary, have been introduced into the cooler parts of France with great advantage, proving superior to the native kinds, and exempt from attacks of rust. We read in 'Les Meilleurs Blés' * of some very disadvantageous changes of seed that have been tried in France. The sorts of wheat that ripen in the west and north-west side of the country are chiefly white varieties, a little late, and very productive of straw and grain, under the influence of mild winters and temperate summers. If these sorts are carried to the warmer inland districts, they are in some seasons destroyed by the winter; if they resist the cold, they often suffer from the heat. If, on the

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* 'Les Meilleurs Blés.' By Vilmorin-Andrieux et Cie. Paris, 1880.

contrary, the change of seed is in the reverse direction, from east to west, from a continental to a maritime climate, the wheat will most probably suffer seriously from rust. The same remarks applied to seed obtained from South Russia and Turkestan. These are all examples of going beyond bounds for seed, and thereby introducing adverse habits and tendencies.

With regard to the ordinary changes of seed from one locality to another, which are common everywhere, it does not appear that any systematic experiments on this interesting subject have been conducted. The practice rests solely on the general belief in its importance. Exact knowledge in regard to the sorting of seed-corn, to suit the localities to which it is sent, must be of great importance to those seedsmen who are engaged in that branch of business. Messrs. Hiram, Sibley, and Co., say very truly in their grain-manual that not one bushel of maize in a thousand is suitable for seed, and they have agents who scour the districts which produce the best grain in search of seed-corn. Customers in Ohio may be supplied from the limestone regions of Nebraska, but certainly not from the sugar-growing region so far south as Louisiana. Mistakes almost as serious might be committed in transferring seed-corn beyond the limits of the proper districts in England. Such firms as Messrs. Oakshott, of Reading, undoubtedly attend to these points, and the series of experiments which I believe that firm have instituted should prove both interesting and advantageous.

In the Vale of Evesham it is found that a change from the hills to the vales, and *vice versâ*, has the effect of increasing the yield of both corn and straw. An old saying in the district is, that "seed-corn should come from sunrise," *i.e.* from the East. Square-head wheat sent from the Vale of Evesham, degenerates in a less favourable locality in Hampshire. Mr. A. M. Savory is in the habit of sending the seed of this variety of wheat to a friend on the Hampshire hills, and when he has grown it there for several successive years, the ears lose their square shape, and the corn becomes thin and flinty, and deteriorates in quality. The same informant says of beans, that the white-eyed sort become black-eyed when they have been grown in the vale for a few years, and a change of beans is more important than in the case of any other kind of seed.

The produce of seed-wheat from Wiltshire, sown by Mr. Robert Russell, in Kent, on the same day as that from the early district of Herne Bay, ripened a week later. Near Windsor, Mr. Trumper says:—

"Our great object is to get seeds that have been grown on chalk, as we find that suits our loams the best. This we can grow safely for two years, or at

most three. After that time, wheat turns smutty if grown longer on the same soil. Corn merchants are accused of putting little bits of chalk in samples of seed-corn to give the idea that they were grown on chalk."

Professor Fream, writing from the chalk at Downton College, says—

"We think change to be desirable, and to do better for us the second year than the first.

"The only object with which it was done is that it is considered, on the whole, to improve the prospect of the crop."

The best stocks of barley in the district have been obtained from Scotland and Norfolk.

Professor James Buckman says of occasional changes, that in Dorsetshire seed from other localities is found to be more productive. In bad climates corn deteriorates, and frequent change of seed is more desirable on that account. In the neighbourhood of Aspatria, Cumberland, seed is brought from an early district, and it is thought better to change the seed pretty often, if not every year.

Still further north, Mr. Melvin, Bonnington, reports the custom of changing seed, "with the object of keeping up the produce. The idea prevails that most varieties, especially of wheat, require to be changed from an earlier district for the above reason. There is another reason, as at seed-time it is only the wheat grown in the earliest district which has become sufficiently dry for sowing. Wheat continuously sown in the Lothians, 150 feet above the sea-level, rapidly deteriorates in quality and quantity of crop. On the sea-level in East Lothian this is less perceptible."

Foreign seed of vetches should come from cool climates; and it is the common practice to change the seed of the rye-grasses from a cooler district. The vigorous habit acquired by the potato in the climate of the north is notorious, and, on the contrary, the comparatively tender habit of the wheat of our southern counties unfits it for the climate of Scotland.

A Yorkshire correspondent says—

"A marked difference is seen in the potato plants from Scotland, the first year's growth being large in top, irregular in the size of tubers, and later in coming to maturity. The second year's growth are less in top, regular in size of tubers, and earlier to mature. We frequently see, if again planted, a marked deterioration. Wheat and oats from the south I have usually found to mature earlier the first year, but to crop better the second."

I believe that M. Rimpau's reply to my question on this subject is as true of other countries as of Germany, and that

the change of seed from one district to another is generally regarded as advantageous, but the soundness of the opinion has not been tested by exact experiments.

Size of the Seeds of Cereals.—Mr. Darwin informs us that Sir J. Hanmer, writing of plants for the flower-garden in 1660, says that, in "choosing seed, the best seed is the most weighty, and is had from the lustiest and most vigorous stems." M. Henry Vilmorin gives the best possible and the briefest answer to my question, "Is the heaviest sample considered the best for sowing?" when he replies, "The heaviest, not the plumpest." The distinction is of great importance. An experimenter assures me that he pruned the seed-stems of a turnip, and thus obtained seeds of unusual size, which proved very inferior in vitality to the seeds of common size. All seeds whose size is thus increased by overfeeding, such as the seeds of wheat planted thinly in the ground, or on land unusually rich, will probably be lighter in proportion to their size, and deficient in constitutional power. It is quite possible that large seeds, though really inferior, may be sown sometimes with success in genial years in kind land, or in cases where over-seeding is customary, because large-sized grain gives less seed per bushel, but that does not affect the general rule that good wheat should be of high specific gravity according to its kind. Many of my informants do not object to small sound seeds of any kind, but a sample of small seed is quite different from the small seed of a sample. I have received sanguine narratives of the increased produce of barley when the small-sized grain had been carefully sifted out. But this cannot, in the face of other evidence, be regarded as a universal method of improving plants.

Over-size seeds are always inferior, although no doubt the seed inherits characters which are in some degree dependent on size, and large seed contains—other things being equal—more of the desirable qualities than small seed, and these are more likely to be propagated and handed down by such seeds, provided they have no defect. It is recognised, however, that very large seed produces a coarse growth. A seed-grower sifted out the very large seeds of mangolds and saved the produce for seed. Not only were the plants thus produced coarser than usual, but the seedsman for whom he had long grown this mangold, though unaware of the experiment which had been tried, detected the degeneracy of the stock.

The vigour of the germ of seeds is not always in proportion to the beauty or plumpness of the grain. Wheat from an inferior soil is usually preferred for sowing, and M. Vilmorin remarks that the best agriculturists of French Flanders, having excellent

wheat-land, obtain the seed every year from a neighbouring canton, less fertile, growing wheat of the same kind which is much less plump, but more vigorous than that of their own growth. No one can speak with more authority than M. Vilmorin on the general subject of this paper, and I am sure all improvers will read with profit the following letter:—

"Antibes, Alpes Maritimes,
"*March 20th*, 1883.

"Dear Sir,

"I have no doubt but the process of improvement which has given such excellent results as applied to vegetables and ornamental plants might also be used successfully in the case of the plants of the farm. The process itself, however, is a long and in most cases a difficult one, and not easily within reach of the farmers.

"The only real process of improvement is that of selection, and there is no other system, in my opinion, by which to arrive at a real and durable modification of the useful plants for the better. Artificial crossing (or as it is very often, but not altogether rightly, called—*hybridisation*) is in fact only a means to induce variation in the cultivated plants, with a view to promote the development of new forms, from which it is hoped that something better than the kinds already known might be obtained by selection. When such a cross takes place, many of the forms raised are worthless, some are very similar to their progenitors, and a few only may be regarded as something better. But even these have no agricultural value until they are propagated to a large extent, and it comes out often during the process of propagation that the new form is not steady enough to be regarded as a fixed race. It is only after several years of cultivation and of careful selection that a new form, even if obtained by an intentional cross, can be developed into a new and distinct race.

"Sports are often produced in cultivated plants without any cross-fertilisation; again, accidental crosses very frequently take place by the agency of insects or of wind, and it is often to new forms which have originated in either of these ways that the process of selection is applied by gardeners or farmers. But it is always in the end by careful and continued selection that a variation, whatever its origin may be, is made to grow into a new, distinct, and fixed race, and as such can become really valuable to the farmer.

"Hybrids, properly speaking, are the offspring of two plants belonging to *different botanical species*, if crossed the one with the other; they are rather rare and generally of limited fertility. The so-called hybrids of the gardeners are simply the offspring of two plants belonging to *two distinct varieties of the same species*. We call them in French *métis* (I think 'mongrel' would be the proper English translation of the word). These are quite prolific, sometimes even more so than the varieties from which they have been raised. But only a few of the plants which grow out of the seeds obtained as the direct result of the cross prove really distinct from and superior to the plants from which the seeds have been produced. If I may mention a fact within my own experience, it was only after six or seven years of continued cultivation and selection, that a new wheat raised by me from two kinds purposely crossed appeared to be sufficiently even and fixed in character to be sent out *on trial*. During the first three or four years, and in spite of the severest selection, it yielded a pretty large percentage of plants different in character from the type I wanted to fix. You will see by that example that the process of raising and making new varieties is a long and tedious one.

"It requires so much time, and engrosses the care and attention so much,

that it seems impossible to expect the seedsmen to enter largely upon that kind of work. Indeed, my opinion is that the duty of the seedsman is to keep pure and true all the varieties of useful plants already known, and to propagate them so as to meet the wants of the public. This task is quite heavy enough, especially if we add to it the care of testing all the new kinds introduced every year, in order to propagate and distribute them when really of some worth. I think that the division of work can be introduced with great advantage here, and consider that it is very wise in the seedsman not to enter too freely the lists for the raising of new kinds. In the first place, such an attempt would take much time and care that can be spent to better purposes; and besides, the raisers of new varieties are in most cases unduly partial to their *novelties*, and the temptation to introduce them to the public indiscriminately would be particularly hard to resist for men who periodically publish trade-lists, and who can rely upon a large body of customers.

"The man who devotes the whole of his time and skill to the improvement of *one* kind of plant is likely to succeed better than he who has so much on his hands already, and this is so far the case, that even now most of the new varieties offered by the great seed firms are very good strains raised by some skilful gardeners, the exclusive property of which is purchased and paid for dearly by the firm.

"It would be a very good thing for the public and for the seedsmen themselves if a larger number of gardeners and amateurs devoted their time to the raising of new kinds upon a methodical plan, as Mr. Laxton has done for peas, beans, and tomatoes, and Mr. R. Fenn for potatoes.

"If you can induce some farmers or country gentlemen with leisure at command to take the same kind of work in hand with respect to the plants of the farm, I think you will have rendered the public a great service. Only you must insist forcibly on this fact, that no work requires more than this a cool judgment and a critical eye, as it must be always borne in mind that every novelty is not a gain, any more than everything that glitters is gold.

"With best assurances of regard,

"I am, dear Sir,
"Yours very truly,
"HENRY VILMORIN."

In this capital letter we may find an argument for botanical gardens and experimental or trial-grounds, such as that at Chiswick for horticultural purposes.

M. Vilmorin commenced the cross-fertilisation of cereals at Verrières, near Paris, ten years ago, and some of the new kinds have been fixed in type, and are now in the course of trial in comparison with the older varieties. Improvers happily are not afflicted with the *vanitas vanitarum* temperament; but it may encourage even the sanguine to know that M. Vilmorin confidently anticipates the success of undertakings such as theirs, believing, as he does, "that none of the plants of the farm have attained as yet, or will attain very soon, the highest possible degree of perfection." That English farmers agree with M. Vilmorin, we may learn from the general curiosity and interest they exhibit at all markets in the yield and quality of the several varieties of wheat, barley, or beans, old or new. They may

not care to give high prices and to send long distances for every advertised novelty, but, so far as their own markets are concerned, they are always seeking for something better than the best they have got at present.*

III.—*Some Field Experiments on the Growth of Turnips, at Rusper, Horsham.* By Bernard Dyer, F.C.S., F.I.C.

The following notes record the results of some experiments carried out in the seasons of 1882 and 1883 on the farm of Mr. A. F. Parbury, of Rusper, near Horsham, in the county of Sussex. The experiments were based on a plan somewhat similar to that of the Woburn turnip experiments, except that attention was directed solely to the use of Cambridge coprolites, raw and dissolved, with and without the addition of dung.

Mr. Parbury was good enough, in the spring of 1882, to place at my disposal a couple of acres of land, and to devote much time, trouble, and, it may be added, expense, to the carrying out of my suggestions: all essential operations, such as the measuring and staking out of the land, the preparation and distribution of the manure, the sowing of the seed and the weighing of the crops, being carried out under the eyes of both of us, and—as far as regards all measurements and weights—by our own hands.

The land is a stiff clay—not, it should be noted, by any means of a mechanical texture naturally adapted to the growth of turnips; but none other was at our disposal, and the particular field selected had the advantage, for experimental purposes, of having been very severely dealt with and badly manured for some time previously. Its recent history was briefly as follows:—1878: kohl-rabi, which crop proved a failure, and was ploughed in. 1879: Winter wheat sown with red and white clover, alsike, and yellow trefoil. 1880: Two clover crops carried. 1881: Clover once cropped, and

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* Messrs. Sutton and Sons have most kindly and zealously afforded me a great deal of useful aid in the course of the inquiries connected with this paper. The same acknowledgment is due to Messrs. Carter and Co., whose trial-grounds at Forest Hill, as well as their seed farms in Essex, have been always open to my inspection. It is not perhaps generally known that the Lindley Library, containing valuable agricultural and horticultural works deposited in the rooms of the Royal Horticultural Society at South Kensington, is open to the public under certain regulations. I have found the library useful both for consultation and for the loan of its books.

fed off with sheep. The wheat of 1879 was top-dressed with 1 cwt. per acre of "concentrated corn-manure"—but no manure was applied in either 1880 or 1881—except that naturally supplied by the sheep consuming the last of the clover in the latter part of the season of 1881.

The two acres of clover ley selected for experiment were ploughed up in the early part of October 1881 to a depth of about 6 inches. The field was well sampled to about this depth, when an analysis of the soil showed it to have the following composition:—

Composition of Experimental Soil, dried at 212° Fahr.

*Organic matter and water of combination ..	7·444
Oxide of iron	4·940
Alumina	5·800
Lime	·672
Magnesia	·366
Potash	·482
Soda	·107
Phosphoric acid	·212
Sulphuric acid	·147
Siliceous matter, &c.	79·830
	100·000
* Containing nitrogen	·225

The field having been, as already mentioned, broken up in October 1881, was cross-ploughed towards the end of April, 1882. Between this date and the end of May, it was "cultivated" with a stout drag-harrow three times, and thus pretty fairly cleaned from the weeds and twitch that had accumulated during the two years' rest.

On the 1st of June one acre was manured with 10 tons of dung, made under cover by sheep fed on cake, corn, and hay. After ploughing in the dung, the field was alternately light harrowed and rolled about six times.

The second acre received no dung.

Each acre was then divided into six equal plots, of which two received no artificial manure, two received equal quantities of superphosphate (dissolved coprolites), and two received equal quantities of ground undissolved coprolites. The superphosphate was put on at the rate of 5 cwts. per acre, and the coprolites (very finely ground Cambridge) at the rate of 6½ cwts. per acre; this being about an equivalent in money-value for the 5 cwts. of superphosphate.

The superphosphate had the following composition:—

Moisture	16·03
Water of combination	10·18
Monobasic phosphate of lime	17·39
Equal tribasic phosphate of lime rendered soluble by acid	(27·24)
Insoluble phosphates	5·39
Sulphate of lime, &c.	45·82
Siliceous matter	5·19
	100·00

The ground Cambridge coprolites analysed as follows:—

Moisture	·87
Water of combination, &c.	3·63
*Phosphoric acid	26·21
Lime	44·13
Oxide of iron, alumina, carbonic acid, &c.	18·02
Siliceous matter	7·14
	100·00

* Equal tribasic phosphate of lime .. .. .. 57·22

There were thus two sets of experiments, each performed in duplicate; the one set being carried out on the acre which had received 10 tons of dung, and the other on the acre that received no other manure than the artificials. Two plots therefore received absolutely no manure, two received dung only, two received dung and superphosphate, two received dung and ground coprolites, two superphosphate only, and two ground coprolites only; each of these twelve plots occupying exactly one-sixth of an acre.

The plots were, as far as possible, arranged so as to diminish errors incidental to inequalities in the land, which sloped somewhat towards the south-east. A hedge runs along the north side of the field; but a good headland intervened between it and the experimental plots; while the nearest hedge on any other side was 40 or 50 yards distant. Hence the exposure to weather was tolerably free, and pretty much the same over the whole space.

The annexed diagram (page 116) shows the arrangement of the plots.

The manure for each plot was mixed with a considerable bulk of sifted earth, and sown broadcast on June 10th, and harrowed in, immediately after which operation, the field was drilled with 3½ lbs. per acre of Carter's "Prize-Winner" Swedes.

Notes of the appearance of the plant were made by Mr. Parbury on July 2nd, July 30th, and August 10th. These, however, are hardly worth recording in detail here, as the

differences noted between the various manured plots were but slight. The "nothing" plots, on the undunged acre, were, however, each noted as starting weakly, and remaining poor and weak to the last; while the plots receiving dung only appeared distinctly poorer than the other plots on the same acre; although they ultimately weighed very well.

W.

S. — N.

No. 1.	No. 2.	No. 3.	No. 7.	No. 8.	No. 9.
94 lbs. super. = 5 cwts. per acre.	122 lbs. ground coprolites = 6½ cwts. per acre.	No artificials.	94 lbs. super. = 5 cwts. per acre.	122 lbs. ground coprolites = 6½ cwts. per acre.	No manure whatever.
No. 4.	**No. 5.**	**No. 6.**	**No. 10.**	**No. 11.**	**No. 12.**
No artificials (same as No. 3).	Super. (same as No. 1).	Coprolites (same as No. 2).	No manure whatever (same as No. 9).	Super. (same as No. 7).	Coprolites (same as No. 8).

DUNGED ACRE. E. UNDUNGED ACRE.

The roots were pulled in the third week of October, being carefully topped and tailed in the field. The tops were weighed on the spot with the aid of a spring-balance, the roots being carted off and weighed in the barn.

The following figures show the weight of cleaned roots and leaves from each plot of one-eighth of an acre:—

PLOTS.		Roots per Plot.				Leaves.		
	FIRST ACRE—10 TONS DUNG.							
		tons.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
1	Superphosphate	1	17	2	0	10	1	22
2	Ground Coprolites	2	4	0	14	13	2	21
3	No Artificials	1	18	0	14	10	3	5½
4	No Artificials	1	13	3	0	8	2	8½
5	Superphosphate	1	16	1	0	10	1	13
6	Ground Coprolites	1	19	0	0	11	2	5

Plots.		Roots per Plot.				Leaves.		
	Second Acre—No Dung.							
7	Superphosphate	1	17	2	14	11	0	8
8	Ground Coprolites	2	1	2	0	12	1	5
9	No Manure	0	8	3	14	5	2	0½
10	No Manure	0	7	0	7	4	2	11
11	Superphosphate	1	16	0	14	11	1	26
12	Ground Coprolites	2	0	2	14	13	3	26

The foregoing figures, calculated, give the following results per acre:—

Plot.		Roots per Acre.				Leaves.			
	First Series—10 tons Dung per Acre.								
		tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.
1	5 cwt. Superphosphate	11	5	0	0	3	2	2	20
5		10	17	2	0	3	1	3	22
	Mean	11	1	1	0	3	2	1	7
2	6½ cwts. Ground Coprolites	13	4	3	0	4	2	0	14
6		11	14	0	0	3	9	1	2
	Mean	12	9	1	14	3	15	2	22
3	No Artificials	11	8	3	0	3	4	3	3
4		10	2	2	0	2	11	2	22
	Mean	10	15	2	14	2	18	0	26
	Second Series—No Dung.								
7	5 cwts. Superphosphate	11	5	3	0	3	6	1	20
11		10	16	3	0	3	8	3	16
	Mean	11	1	1	0	3	7	2	18
8	6½ cwts. Ground Coprolites	12	9	0	0	3	13	3	2
12		12	3	3	0	4	3	3	16
	Mean	12	6	1	4	3	18	3	9
9	No Manure whatever	2	13	1	0	1	13	0	3
10		2	2	1	14	1	7	2	10
	Mean	2	7	3	7	1	10	1	6

On carefully examining and comparing the foregoing Tables, together with the plan of the field, it will be noticed that all the plots on the western side of the field gave better results than their duplicate neighbours on the eastern side, showing that this part of the land must have been naturally more productive. The differences, however, are not on the whole great, and as they pervade the series, the mean result of each pair of duplicates may be regarded as correctly showing the effect of the manure applied.

Taking, in the first place, the plots that received no dung and no artificials, we find that the soil, unassisted by manure of any kind, produced less than $2\frac{1}{2}$ tons of roots per acre.

If we subtract this weight from the mean yields of the other plots, we shall get the following results in the shape of increase due to the manures employed :—

Increase of Roots per acre due to Manures over and above the Yield of Unmanured Land.

Manure per acre.	Tons.	cwts.	qrs.	lbs.
10 tons dung	8	7	3	7
10 tons dung and 5 cwts. superphosphate ..	8	13	1	21
10 tons dung and $6\frac{1}{2}$ cwts. ground coprolites ..	10	1	2	7
5 cwts. superphosphate only	8	13	1	21
$6\frac{1}{2}$ cwts. ground coprolites only	9	18	1	25

It is singular that while the dung alone gave an increase of $8\frac{1}{2}$ tons nearly, and while a larger increase was given by the artificials used alone, yet where the dung was used in addition to the artificials, it will appear to have had no effect. By an odd coincidence, the mean of the superphosphate plots happens, indeed, to work out at precisely the same figures both on the dunged and on the undunged acre; and there is practically no difference between the mean of the coprolite plots with and without dung.

That the ground coprolites gave in these experiments better results than the superphosphate, occasioned me some surprise, but there was no doubt as to what would be the ultimate result of the weighing as soon as the roots were pulled; for those from the coprolite plots were cleaner, larger, and rounder, than any of the others. It is to be noted that the proportion of phosphate actually applied per acre was more than twice as much in the $6\frac{1}{2}$ cwts. of coprolites as in the 5 cwts. of superphosphate; but I was inclined to attribute the less satisfactory effect of the superphosphate to the natural poverty of the soil in carbonate of lime. The total proportion of lime in the soil was not much more than one-half per cent.; and this appears to exist in the form of silicate, since the dry soil does not effer-

vesce in the slightest degree when treated with hydrochloric acid; while it would effervesce very markedly if the lime were present as carbonate. It is well known that superphosphate acts most readily in soils containing plenty of carbonate of lime, and it seemed very probable that the scarcity of lime militated against the efficiency of the superphosphate.

As will be seen from the following record of the rainfall, registered on the farm in Mr. Parbury's rain-gauge, more than $3\frac{1}{2}$ inches of rain fell between the time of sowing on June 10th and the end of July, rather more than $1\frac{1}{4}$ inch during August, nearly 3 inches in September, and more than $1\frac{1}{4}$ inch in the early part of October.

Rainfall at Rusper, 1882.

	Inches.
From June 10th to 30th	0·64
„ June 30th to July 31st	3·03
„ July 31st to August 31st	1·28
„ August 31st to September 30th	2·85
„ September 30th to October 13th	1·28
„ June 10th to October 13th	9·08

Mr. Parbury was good enough to offer to continue the experiment, by growing oats on the same plots in the following season, a suggestion which appeared valuable, as promising some indication of the comparative after-effects of the manures already applied to the turnip-crop.

The experimental field was accordingly sown with oats in the spring of 1883, and the produce of each of the twelve plots was carefully kept separate during harvesting, and subsequently threshed separately, the corn and straw being measured and weighed. The following figures record the weights of both grain and straw from each of the plots. It is to be remembered in reading the Table that the manures mentioned were those applied, as already described, to the turnip-crop of the previous year, no additional manure whatever being used for the oats, either at sowing or by way of top-dressing.

Plot.		Oats per Plot.			Straw per Plot.
	First Acre—10 tons Dung.				
		bush.	pecks.	galls.	lbs.
1	Superphosphate	8	2	0	470
2	Ground Coprolites	9	2	0	434
3	No Artificials	8	2	0	430
4	No Artificials	9	2	$1\frac{1}{2}$	445
5	Superphosphate	8	2	0	450
6	Ground Coprolites	8	3	1	404

Plots.		Oats per Plot.			Straw per Plot.
	Second Acre—No Dung.				
7	Superphosphate	7	0	0	409
8	Ground Coprolites	8	2	1	418
9	No Manure	9	1	0	539
10	No Manure	6	2	0	386
11	Superphosphate	10	0	1½	525
12	Ground Coprolites	9	1	1	479

The foregoing figures calculated out to yield per acre give the following results:—

Plot.		Oats per Acre.			Straw per Acre.		
	First Series—10 tons Dung per Acre.						
		bush.	pecks.	galls.	tons.	cwts.	lbs.
1	5 cwts. Superphosphate	51	0	0	1	5	20
5		51	0	0	1	4	12
	Mean	51	0	0	1	4	72
2	6½ cwts. Ground Coprolites	57	0	0	1	3	28
6		53	1	0	1	1	72
	Mean	55	0	1	1	2	50
3	No Artificials	51	0	0	1	3	4
4		58	0	1	1	3	94
	Mean	54	2	0½	1	3	49
	Second Series—No Dung.						
7	5 cwts. Superphosphate	42	0	0	1	1	102
11		61	0	1	1	8	14
	Mean	51	2	0½	1	5	2
8	6½ cwts. Ground Coprolites	51	3	0	1	1	56
12		56	1	0	1	5	74
	Mean	54	0	0	1	3	65
9	No Manure	55	2	0	1	8	94
10		39	0	0	1	0	76
	Mean	47	1	0	1	4	85

Subtracting the mean yield of the totally unmanured plots from those of the various manured plots, we get the following increase, apparently due to the manures used for the turnip-crop. I say "apparently" advisedly, for there are discrepancies between some of the duplicate plots, which render it impossible to draw unqualified inferences from the mean figures:—

Increase of Oats per acre on Manured Plots over and above the Mean Produce of Unmanured Plots.

Per acre.	Bush.	pecks.	galls.
10 tons dung	7	1	0½
10 tons dung and 5 cwts. superphosphate ..	3	3	0
10 tons dung and 6½ cwts. ground coprolites ..	7	3	1
5 cwts. superphosphate only	4	1	0½
5 cwts. ground coprolites only	6	3	0

It is to be remembered that all the turnips were carted off, and not consumed on the field, so that the oat-crop was absolutely unmanured, save for the residues of the manures applied in the spring of the preceding year, and was therefore not grown as in ordinary good farming practice. It is striking that far from the worst of the oat-plots was plot No. 9—a totally unmanured plot—which during the previous year produced turnips at the rate of only 2 tons 13 cwt. per acre. The other unmanured plot (No. 10), which yielded at the rate of 11 cwt. less turnips per acre than No. 9, gave also 16 bushels per acre less of oats than the latter.

In order to test how far the scarcity of carbonate of lime in the soil might be responsible for the superior efficacy of the ground coprolites, as compared with superphosphate, on the turnips of the preceding year, Mr. Parbury kindly undertook a fresh series of turnip experiments in a field on another part of the farm.

The two acres chosen for this purpose were in the middle of a field, the recent history of which was as follows:—1878–9, winter oats (no manure); 1880, bare fallow, 18 loads dung, for winter wheat; 1881, white wheat, no further manure; 1882, oats. No manure, therefore, had been applied since the autumn of 1880, and the land was in very low condition. It was ploughed up in October 1882, and "cultivated," rolled, and harrowed, in April 1883.

Various portions of the two acres of soil were sampled for analysis as shown on page 122.

It will be seen that the soil has a chemical composition, on the whole very much resembling that of the field chosen for the previous trials. Its mechanical texture—a stiff clay—was also similar, but there was in the new field somewhat more lime than in the old one, though very little of this lime was in the

form of carbonate. It was therefore resolved to lime this field, and accordingly 470 bushels of lime were spread over the two acres, and after due exposure to the air, well ploughed in, and harrowed. One of the two acres marked out was dunged—as in the previous years' trials—with 10 tons of dung (short dung, made by cows and horses), and during May and June the dung was ploughed in, and the field drag-harrowed and light-harrowed four times.

Composition of Soil dried at 212° Fahr.

*Organic matter and water of combination ..	8·521
Oxide of iron	6·066
Alumina	4·364
Lime	·970
Magnesia	·500
Potash	·772
Soda	·176
Phosphoric acid	·141
Sulphuric acid	·137
Siliceous matter, &c.	78·353
	100·000
* Containing nitrogen	·216

The artificial manures were sown broadcast on the 12th of June, the land being immediately afterwards light-harrowed and rolled; on June 15th, $3\frac{1}{2}$ lbs. per acre of swedes were drilled, as in the preceding year.

The manures used had the following composition:—

Superphosphate (Dissolved Coprolites).

Moisture	14·60
Water of combination, &c.	9·61
Monobasic phosphate of lime	17·78
Equal tribasic phosphate of lime rendered soluble by acid	(27·83)
Insoluble phosphates	3·38
Sulphate of lime, &c.	46·67
Siliceous matters	7·96
	100·00

Ground Coprolites.

Moisture	·68
Water of combination, &c.	4·86
*Phosphoric acid	25·97
Lime	43·73
Oxide of iron, alumina, carbonic acid, &c.	16·91
Siliceous matter	7·85
	100·00
* Equal tribasic phosphate of lime	56·69

The arrangement of the plots was somewhat different, each acre being divided longitudinally into six strips, instead of being divided, as shown in the plan of the 1883 experiments. The plan of the plots in 1884 was as follows :—

W.

No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	
No manure.	94 lbs. super-phosphate = 5 cwts. per acre.	122 lbs. coprolites = $6\frac{1}{2}$ cwts. per acre.	No manure.	94 lbs. super-phosphate = 5 cwts. per acre.	122 lbs. coprolites = $6\frac{1}{2}$ cwts. per acre.	No Dung.
No. 7.	**No. 8.**	**No. 9.**	**No. 10.**	**No. 11.**	**No. 12.**	
No artificials.	94 lbs. super-phosphate = 5 cwts. per acre.	122 lbs. coprolites = $6\frac{1}{2}$ cwts. per acre.	No artificials.	94 lbs. super-phosphate = 5 cwts. per acre.	122 lbs. coprolites = $6\frac{1}{2}$ cwts. per acre.	10 tons Dung.

S. N.

E.

The roots were pulled at the end of October, when the various plots gave the following yields :—

Plot.		Roots per Plot.				Leaves.		
	First Acre—No Dung.							
		tons.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
1	No Manure	0	3	2	21	2	3	9
2	Superphosphate	0	18	0	0	6	3	26
3	Ground Coprolites	0	16	2	22	6	0	2
4	No Manure	0	5	3	15	3	1	3
5	Superphosphate	0	16	2	0	8	1	21
6	Ground Coprolites	0	16	3	0	7	1	23
	Second Acre—10 tons Dung.							
7	No Artificials	1	12	0	14	11	3	25
8	Superphosphate	1	8	2	0	10	0	3
9	Ground Coprolites	1	2	3	0	7	0	8
10	No Artificials	1	1	0	14	7	2	23
11	Superphosphate	1	2	3	0	8	3	18
12	Ground Coprolites	1	5	3	24	9	2	8

The foregoing figures, calculated to the yield per acre, give the following results:—

Plot.	Manure per Acre.	Roots per Acre. tons.	cwts.	qrs.	lbs.	Leaves. tons.	cwts.	qrs.	lbs.
	First Series—No Dung.								
1	No Manure	1	2	0	14	0	16	3	26
4		1	15	1	6	0	19	2	18
	Mean	1	8	2	24	0	18	1	8
2	5 cwts. Superphosphate	5	8	0	0	2	1	3	16
5		4	19	0	0	2	10	2	14
	Mean	5	3	2	0	2	6	1	2
3	6½ cwts. Ground Coprolites	5	0	0	20	1	16	0	12
6		5	0	2	0	2	4	2	26
	Mean	5	0	1	10	2	0	1	19
	Second Series—10 tons Dung per Acre.								
7	No Artificials	9	12	3	0	3	11	3	10
10		6	6	3	0	2	6	0	26
	Mean	7	19	3	0	2	19	0	8
8	5 cwts. Superphosphate	8	11	0	0	3	0	0	18
11		6	16	2	0	2	13	1	24
	Mean	7	13	3	0	2	16	3	7
9	6½ cwts. Ground Coprolites	6	16	2	0	2	2	1	20
12		7	15	3	4	2	17	1	20
	Mean	7	6	2	16	2	9	3	20

Deducting from the manured plots the yield of the totally unmanured plots, we have the following average increase attributable to the manures employed:—

Increase of Roots per acre due to Manures over and above Yield of Unmanured Land.

Manure per acre.	Tons.	cwts.	qrs.	lbs.
10 tons dung	6	11	0	4
10 tons dung and 5 cwts. superphosphate	6	5	0	4
10 tons dung and 6½ cwts. ground coprolites	5	17	3	20
5 cwts. superphosphate only	3	14	3	4
6½ cwts. ground coprolites only	3	11	2	14

It will be noticed that dung alone appears to have given a better yield than dung and artificials. But it may also be noticed that the two plots from which the mean yield of dung alone is calculated, differ very widely between themselves; for while one gave 9 tons 12 cwts. 3 qrs. of roots per acre, the other only gave 6 tons 6 cwts. 3 qrs., from which it is evident that Plot No. 7—on the south-east side—must have been in better agricultural condition than the rest of the experimental field. The superiority of the crop on this plot was apparent throughout the growth. If the smaller of the "dung-only" plots be taken as a basis, the increase due to 10 tons of dung would work out at 4 tons 18 cwts. 0 qrs. 4 lbs. per acre.

It will be noticed that the results of the previous year, on the soil poor in lime, were reversed, inasmuch as the superphosphate in the limed soil gave better results than the ground-coprolites; but the difference in favour of the superphosphate was only slight. However, as will have been seen, the crop was a wretchedly poor one—in all practical senses a failure—mainly, no doubt, owing to the very dry weather in August.

The rainfall registered on the farm was as follows:—

	Inches.
June 16th to 30th	1·85
July	2·33
August	·67
September	4·41
October	2·71
	11·97

During August the dryness of the weather—the danger of which chiefly militates against the successful growth of turnips on stiff-clay land—punished the crop so severely that it never regained vigour; and so the experiment can hardly be regarded as a fair or satisfactory one.

The results of the 1882 experiments were indisputably such as to show that under some conditions on stiff-clay soil, poor in lime, finely-ground Cambridge coprolites are capable of increasing the turnip-crop by nearly 10 tons an acre, under circumstances in which an equivalent value of superphosphate (dissolved coprolites) only gave an increase of about $8\frac{3}{4}$ tons; and it would furthermore appear that the ground coprolites produced a more favourable effect on the subsequent crops than did the superphosphate, though the discrepancies in the oat plots, and the general unevenness of this crop as seen in the field, prevent any decided conclusions being drawn with regard to this point.

The turnip-experiments of 1883, which consisted in a repe-

tition of those of 1882, on a neighbouring field, but with the addition of lime to the land, again showed that finely-ground coprolites possess a substantial manurial value; but they no longer proved better than superphosphate; and it is my opinion, based upon the early appearance of the young crop in the field in its earlier stages, that the superphosphate would have proved itself very decidedly better than the ground coprolites, had the crop not been crippled and spoilt, as already described.

17, Great Tower Street, London,
February 1884.

IV.—*Report on the practice of Ensilage, at Home and Abroad.* By H. M. Jenkins, F.G.S., Secretary of the Society and Editor of the 'Journal.'

Introduction.

In the spring of last year it was suggested by Mr. James Howard, M.P., at one of the meetings of the "Journal Committee," that the time was arriving when the Royal Agricultural Society might usefully set on foot an investigation into the process of *Ensilage*, and its suitability for the preservation of English fodder crops. Having inspected many silos on the Continent during a series of years, but mostly those in which green maize is stored, I felt that the investigation was one which ought to be undertaken by a practical farmer who had not already committed himself to any opinion on the subject, who could observe well, and who could put the results of his observations into a readable and useful shape. No doubt there are many such men in England, and a list of some of them was made. A few of these gentlemen were invited in rotation; each one seemed, at first, pleased with the idea, considered it carefully, and finally declined, chiefly on the score that he could not be absent from his farm at the periods and for so long as seemed to be necessary. As time that could not be recalled was rapidly being consumed in this manner, the Journal Committee expressed their willingness to accept my services, *faute de mieux*, rather than that another season should be lost. I have done my best, under all the circumstances, to carry out their wishes, having seen a considerable number of silos filled, some opened, and a great many in full work, both in England and France. I have also obtained and handed to Dr. Voelcker for analysis a large number of illustrative specimens. It is infinitely to be regretted that Dr. Voelcker's promised contribution on the "Chemistry of Ensilage" cannot accompany this Report, owing

to my respected colleague's severe indisposition. The following pages will therefore only embody the chief facts which I have collected, and the inferences which I have myself drawn.

So much has already been written about *silos* and *ensilage* * that an explanation of the terms may be regarded as unnecessary by those who read agricultural books and newspapers. These are, however, a minority of farmers; but it is not impossible that some who have not studied what has been already published may be induced to read this Report. I may also say that there is a certain amount of confusion in the prevailing use of the term "*ensilage*," which makes it necessary to give precision to the language which I shall use, by commencing with definitions, in the same way as Acts of Parliament generally include "Interpretation Clauses," namely—

Silo:—the structure in which the fodder is preserved.

Silage:—the fodder pitted or otherwise preserved.

Ensilage:—the process of preservation.

The Americans are chiefly responsible for the confusion to which I have referred. Mr. Thurber, for instance, in the Introduction to his book 'Silos and Ensilage' explains that "the term of M. Goffart '*Ensilage de Maïs*' has been abbreviated in this country to *Ensilage*, and is supposed to apply solely to fodder-corn [green maize] thus preserved, unless modified, by naming some other crop, as ensilage of rye, &c." † Little importance need have been attached to this alteration of meaning if it had been universally known in this country, but many English farmers have read some of the optimist American statements, when reproduced in England, as if the word "*ensilage*" referred to the process, and therefore as if the results described were due to the superiority of this process over any other for preserving fodder for winter use. During my recent investigations I was pleased to find that the three terms suggested above had occurred independently to others, and were already being used by them.‡

History.

A silo was originally by destination, if not by derivation, neither more nor less than a cellar. M. Littré § finds the deriva-

* See especially "Silos for British Fodder Crops," published at the 'Field' Office.

† In English we have a similar practice in the case of the word "bread," by which we mean wheaten bread. When we wish to talk of any other kind of bread we mention the chief ingredient, *e.g.*, rye-bread.

‡ For instance, Mr. W. Biddell, M.P., has already used the term "*silage*" in a communication which has been published in the Agricultural, and some other newspapers, *e.g.* 'Ipswich Journal,' February 9th, 1884.

§ Silo—*s. m.* Excavation ou fosse creusée dans le sol, où l'on dépose les grains battus pour les conserver.

Fig. Dans les cavernes les os gardaient fidèlement la forme que la vie leur

tion in the Greek *siros*, but many philologists maintain that it is an Arabic word. Be that as it may, it is certain that "far back in the ages" underground pits or cellars were used, and are still used, in Eastern countries for the storage of grain, instead of placing

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avait donnée pour une heure; lorsque des hommes instruits et intelligents descendirent dans ces silos de l'histoire, ils ne commencèrent pas par s'apercevoir des trésors que le destin y avait successivement accumulés.—FOUVIELLE, Presse scientif., 1865, t. i. p. 162.

Fossés recouverts de terre dans laquelle on place les betteraves pour les conserver.

Coffres en charpente, isolés et suspendus, employés pour remuer le blé et le ventiler.

ETYM.—Espagn. *silo;* du grec *σιρὸς*, silo.

E. LITTRÉ, 'Dictionnaire de la langue française,' t. iv.

SILO,—*s. m.* (mot espagn., même signif.). Fossé souterrain où l'on conserve le grain.

Sorte de punition, infligée à nos soldats, en Afrique, et qui consistait à les enfermer dans une espèce de cachot souterrain. Condamner à trois jours de *silo.* Les silos sont d'un usage constant chez plusieurs peuples du Midi, qui en ont reçu la pratique des Romains. Nous ne les connaissons en France que depuis 1810, époque où Jourdain les étudia chez les Basques, qui leur donnent ce nom. Ce sont des sortes de puits secs en forme de carafe, ou d'entonnoir renversé. Leur profondeur est communément de trois mètres, et les parois ainsi que le fond en sont revêtus de nattes de paille. Il y a des silos construits dans le roc et qui ont plus de 25 mètres de profondeur. Dans les silos ordinaires, le blé se conserve un an sans y toucher, et, en renouvelant la paille, une vingtaine d'années et plus.

MAURICE LACHATRE, 'Nouveau Dictionnaire Universel,' t. ii. p. 1333.

[TRANSLATION.]

October 4, 1883.

As regards the word "*silo,*" from which is derived "*ensilage,*" you remember that we found it in the dictionary of the 'Académie Française,' of 1835; but it does not give the origin. This origin is "basque" (a little ethnographic district on the top of the Pyrenees, and extending on either side into France and Spain). In fact I find in the 'New Course of Theoretical and Practical Agriculture,' Paris, 1822:—

SILO = "basque," name for that which corresponds to a grain-pit (*Bose*).

Olivier de Serres, Seigneur du Pradel, who was born in 1539, and died in 1619, author of 'Théâtre d'Agriculture et Mesnage de Champs,' published in 1600, did not know the word "*silo,*" but knew its meaning under the name of "*cros.*" Below is his description (vol. i. p. 163. Edition of 1804, Paris, Huyard):—

"There remains for me to speak about another sort of granary, as novel as any I have seen, as there seems reason to disbelieve the experience of good found in their use. They are used in La Gascoyne and La Guyenne, where they employ these granaries more than in any other province of this kingdom. They are deep pits dug in the ground, called "*cros,*" into which one descends with ladders for bringing in or carrying away the fodder, &c. PLINY considered such pits to be the best way of preserving corn, &c., as was practised in his time in Thrace, Cappadocia, Barbary, and Spain. VARRO was also of his opinion, asserting that wheat can be kept sweet and entire, 50 years, and millet 100: at the same time stating so as to strengthen his opinion, that when Pompey the Great was sweeping the sea of pirates, there was found at Ambratia a large supply of beans (in good and sound condition), in a cavern where they had remained stored away since the time when King Pyrrhus was fighting in Italy, and nearly 120 years had then passed."

To this passage corresponds the following note (page 181, vol. i. same edition), YVART, member of the Institute, being the author:—

"In 1707 there was discovered in the citadel of Metz a large quantity of corn,

it in granaries above ground. The main object, especially of nomadic tribes, was to prevent marauders or victorious enemies from obtaining possession of their stores. The Spaniards learnt the practice from the Moors, and in Spain it gradually acquired a new importance for a purely commercial object, namely, the preservation of corn in times of plenty and low prices until times of scarcity and high prices. From the Basque provinces it found its way into France, where it had a very severe struggle for existence, but where it may now be seen on a large scale, at the stables of the Paris Omnibus Company, some silos being below ground and some above.*

In France, the system of ensilage was originally imported from Spain with a view to the preservation of cereals from years of plenty to years of scarcity. It is recorded by Mons. L. Doyère,† that the proprietor of the estate of Palerne, in the Puy de Dôme, put his corn harvested in 1820 and 1821 in silos constructed for the purpose, and kept the grain in them until the end of 1828, when, prices having risen to double their figure of seven years before, he opened the silos and found the grain practically uninjured. It is true that a small layer at the top, immediately under the straw which separated the grain from the hermetically sealed cover, was a little mouldy, and the silo contained a quantity of carbonic-acid gas when first opened. But the bulk of the grain was perfectly preserved, and the proprietor of the estate was so satisfied with his success that he

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placed there in 1528, in one of the underground rooms, where it was so well preserved that the bread which was made from it, two centuries after it had been placed there, was found very good. There exists now (1804) at Ardres, department of the Pas de Calais, one of these underground places made by the Romans."

"A number of examples might be cited of grain very well preserved in similar underground pits, which ought always to be placed in very dry places, with the precaution of cutting off all access to the outer air, by covering the corn with a layer of powdered lime slightly moistened. If it be desired to have fuller details relative to this way of preserving corn, as also with regard to the stores employed at the present time successfully for the same object, the article on 'Wheat' in the 'Course of Agriculture' by Rozier should be consulted. There are to be found the methods of Duhamel, Parmentier, and Bucquet. The work of Barthélémy Inthiery should also be consulted. It is entitled 'The Art of preserving Corn.' These different works leave nothing to be desired in an object of so great an importance, which has also been well treated by M. Cailleau, in a memoir inserted in the 'Journal of the Royal Society of Agriculture of Paris,' spring quarter, of 1788. It would also be desirable to refer to the word '*Conservation*' in the 'Encyclopédie Méthodique, Dictionnaire d'Agriculture.'

(Signed) "T. Laverrière."

* I have inspected some of these silos with my friend, M. Lavalard, the General Manager of the Company. A description of them, with an exhaustive discussion of the questions involved, will be found in a Report by M. Müntz, 'Etudes sur la Conservation des Grains,' published in the 'Annales de l'Institut National Agronomique,' No. 4 of 1878–79, published in 1881.

† 'Recherches sur l'Alucite des Céréales;' Paris, 1852, p. 102.

gave instructions for other silos to be built. Unfortunately, his death shortly afterwards put an end to his projects.

So far as I can judge, the first Frenchman to call attention to this method of preserving corn was the Count de Lasteyrie, who published a work on the subject in 1819. Then a trial of the system was made by M. Ternaux at Saint Ouen, and the "Sociéte royale et centrale d'Agriculture de France" appointed a commission to report on the experiment. This report, presented in December 1826, was eminently unfavourable, and for a considerable time prevented any further attempts at the ensilage of corn. M. Doyère explains that the conditions under which the experiment was made were so extremely unfavourable, that failure was a foregone conclusion. He mentions specially a very porous subsoil close to the Seine, and subject to infiltrations of water from it, no attempt to render the walls of the silo water-tight, and so forth. Therefore one need not wonder that the corn was not well preserved.

After the publication of M. Doyère's report on the *Alucite* of wheat, he was commissioned by the French Government to investigate more closely the question of the preservation of cereals in *silos*, more especially in Spain. His report was presented to the French Academy of Sciences at the end of 1855, and published the following year as a pamphlet.* Without stopping to analyse this Report, I think it desirable to give the following translation of an article from a French Encyclopædia,† which embodies most of M. Doyère's conclusions:—

[Translation.]

" *The Preservation of Cereals.*—This question interests in the highest degree every civilized country. It is important for the welfare of nations that, when the harvest is superabundant and the corn at a low price, a part of the produce in excess should be preserved, so as to circulate the same when a bad harvest arrives unexpectedly, and the price of corn tends to rise above the ordinary value. But two natural obstacles exist to the preservation of corn. They are (1) the dampness which causes it to ferment, and (2) the insects which destroy considerable quantities of it. In Egypt, where it never rains, and in other countries where rains are rare, the problem is easily solved by the employment of the "silo." The "silo" is simply an excavation, the sides of which are lined with masonry, then relined, as also is the bottom, with a layer of very dry straw. After the pit or silo has been filled, the grain is covered with straw, and the silo is closed by means of an arch in masonry, in which is placed an opening with a movable lid, so that one can take out the grain from it as needed. The grain is preserved in the silo,

* 'Mémoire sur l'ensilage rationnel, système nouveau pour conserver les grains d'après les données positives de la science et de la pratique, sans déchet, sans perte de qualité, sans travail, et à moindres frais que dans tout autre système.' Par M. L. Doyère.

† 'Dictionnaire Français illustré et Encyclopédie Universelle, par B. Dupiney de Vorepierre,' Paris; Michel-Levy frères. 1867, t. i. p. 503.

without injury, for an indefinite time. But in France, as in all northern countries, the ensilage of the grain has not succeeded, and this is attributed to the humidity of the soil, which penetrates to the interior of even the best constructed silos. Then it has been observed that corn properly ventilated is less subject to become heated in the granaries than that left alone. It was believed that the problem had been solved by the airing and ventilation of the grain. Moving granaries and granaries with ventilators were suggested, but they are all extremely expensive, and they do not safely prevent fermentation. They also put no obstacle to the development of insects. The success that has been obtained by using these means appears to be simply due to the dryness of the wheat. But, as DOYÈRE has asserted, dry grain can be preserved for a certain time by any means. But it is not the same with wet grain, that is to say, grain containing more than 16 per cent. of water, like the greater part of French corn does. "I found," says DOYÈRE, "that corn containing 21 per cent. of water furnishes, at 68° Fahr. (20° Centigrade), 120 milligrammes of carbonic acid per day and per kilogramme (about 2½ lbs. English) in a state of rest; and about 17 milligrammes per hour under the influence of a constant current of air, which latter amount would make 408 milligrammes per day. Ventilation therefore trebles the amount of decomposition, of which carbonic acid is one of the products. The last of these losses is enormous, for it represents not less than 2½ per cent. of dry matter destroyed each month, owing to alcoholic fermentation. It is probable that it would not be continued indefinitely to the same extent as it happens for several hours; but it is renewed with the same energy during the whole time of an intermittent ventilation. Otherwise, the loss of 120 milligrammes of carbonic acid per day, which hardly requires any renewal of air, suffices to repel the hope of a preservation of long duration, for it represents a destruction of dry matter amounting to 7 per 1000 per month. This is not only the loss in weight, for the loss in quality which results from the formation of sour and rank products is incomparably more to be feared. Finally, as the loss takes place in a temperature relatively low, that of 68° Fahr., it would not only increase with the temperature, but even much more rapidly. Therefore when the grain is wet, the airing produces an effect very much opposed to that which is commonly looked for." The results of the experiences of DOYÈRE show that, in the grain containing less than 16 per cent. of water, there is only produced an alcoholic fermentation, excessively weak, without developing odour or taste, and only to be perceived by the most delicate processes of chemistry.

In other cases, even this fermentation is stopped in closed vessels. After the oxygen of the air, which is its primitive cause, has completely disappeared, no other acid but carbonic acid is formed; the starch and gluten undergo no change. Towards 16 per cent. of humidity, or a little beyond it, the alteration in the grain begins to show itself, in the course of time, in the closed vessels. Its relative activity in corn of various degrees of humidity increases with the proportion of water, but much more rapidly than the humidity itself. It is due to fermentation, called by the chemists lactic, butyric, and gaseous. Consequently, whatever may be the means employed, it is impossible to preserve grain wet, as it generally is in France. The excessive humidity of corn in our country ought not, however, to be attributed only to the climate and climatic influences in which the grain has been harvested. Agricultural customs have much to do with it. In the greater part of France the wheat is cut half green, and is hastily put into the granary or made into ricks, where it immediately begins to ferment. If, as we think, the observations of DOYÈRE are correct, it is evident that the corn intended to be preserved must be dried in the first instance, if it contains 16 per cent. of humidity or more. As to the place where it is best to keep it, the silo appears

to us infinitely preferable to the granary, for the latter is open to the outer air, and exposed to all variations of temperature. Now, air introduces a means of fermentation of the grain as well as a means of life for insects, while variations of temperature favour the chemical phenomena of which the grain becomes the seat. The underground silo in masonry offers this great advantage over the granary: that of preserving a low and constant temperature; but it is not completely inaccessible to the air, and it is impossible to render it impervious to humidity. As a set-off to these two last inconveniences, DOYÈRE proposed employing metals. His system of construction consisted of some very thin sheets of iron, preserved exteriorly from oxydation by an impermeable covering, and enveloped in concrete, which sustains the whole weight. The sheet of iron, he says, only plays the part of an impervious and indestructible varnish. It offers, besides, the advantage of supplying holes which can be shut up hermetically. Finally, a silo of 500 hectolitres, constructed according to this system at Paris, with a sheet of iron of a mean thickness of 3 millimetres, and made at a cost of 2*l.* the cwt. (1 fr. per kilo.), has only cost, including the asphalte covering, 2250 francs (90*l.*), or 4 fr. 50 c. per hectolitre (1*s.* 4*d.* per bushel). Therefore it is seen that instead of being led into error by ruinous experiments on the faith of theories, either preconceived, or else deduced from facts wrongly interpreted, it is simply a question of appropriating for our climate the means consecrated by the experience of centuries in all warm countries.—*Dictionnaire Français illustre et Encyclopédie Universelle.* Par B. DUPINEY DE VOREPIERRE. Tome 1er, page 503. Paris. Michel Levy frères. 1867.

I have given these details as to the origin of ensilage partly as a matter of history, and partly on account of their bearing on the whole question of ensilage; but chiefly because it may possibly be found useful in some of our colonies to adopt the ancient method of storing grain. It is due to my excellent friends MM. Laverrière and Lesage, the former librarian to the "Société Nationale d'Agriculture de France," and the latter to the French Ministry of War, to state that it is entirely owing to their kindness that I have been able to place this portion of the subject so clearly before the readers of the 'Journal.'

Leaving now the ensilage of cereals, I proceed to sketch the modern history of the application of the system to the preservation of green crops for winter use.

If British farmers have not until the last two or three years attempted to preserve their fodder-crops in silos, it is not because the system has not been previously brought under their notice. So far back as 1843, Professor J. F. W. Johnston described the German system clearly and in detail in the 'Transactions of the Highland and Agricultural Society' (New Series, vol. ix. p. 57). It seems to me useful to reproduce an extract from this paper, as most members of the Royal Agricultural Society are unable to obtain access to that excellent contribution to our knowledge of the subject.*

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* Mr. H. R. Stevens ('Silos and Ensilage,' p. 20) makes the following curious statement:—"This process is fully described by Grieswald (1842); and a trans-

"A method has lately been tried in Germany, which, by the aid of a little salt, seems in a great measure to attain this object.* Pits are dug in the earth from 10 to 12 feet square, and as many deep; these are lined with wood, and puddled below and at the sides with clay. They may obviously be made of any other suitable dimensions, and may be lined with brick. Into this pit the green crop of grass, clover, or vetches is put just as it is cut. Four or 5 cwts. are introduced at a time, sprinkled with salt, at the rate of 1 lb. to each cwt., and if the weather, and consequently the crop, be dry, two or three quarts of water to each cwt. should be sprinkled over every successive layer. It is only when rain or a heavy dew has fallen before mowing that, in East Prussia, this watering is considered unnecessary. Much, however, must depend upon the succulency of the crop. Each layer of 4 or 5 cwts. is spread evenly over the bottom, is well trodden down by five or six men, and, especially, is rammed as close as possible at the sides with the aid of wooden rammers. Each layer is thus salted, watered if necessary, and trodden in succession till the pit is perfectly full. Much depends upon the perfect treading of the grass for the exclusion of the air, and, therefore, for a pit of 10 feet square, 4 cwts. are as much as ought to be put in for each layer. Between each layer may be strewed a few handfuls of straw, in order that, when emptying the pit afterwards for the daily consumption of the stock, the quantity taken out may be known without the necessity of a second weighing. When the pit is full, the topmost layer is well salted, the whole then covered with boards or a well-fitting lid, and upon these a foot and a half of earth, for the more perfect exclusion of the air. A pit 10 feet square, and as many deep, will hold about 5 tons of fresh grass, and each pit should, if possible, be filled in not less than two days.

"When covered up, the grass speedily heats and ferments, and after the lapse of about six days, when the fermentation has ceased, the whole has sunk to about one-half of its original bulk. The lid must be examined during the fermentation at least once a day, and the earth, as it sinks, carefully replaced wherever crevices appear; for, if the air be allowed to gain admission, a putrefactive fermentation will come on, which will impart a disagreeable odour to the fodder, though it will not prevent it from being readily eaten by the stock. When the first fermentation has ceased, the lid may be removed, the pit again filled with fresh grass, trodden in, salted, and covered as before. A pit 10 feet square, when perfectly full of this fermented grass, will contain nearly 10 tons—equal to 2 or 3 tons of dry hay. The grass, when thus fermented, *has the appearance of having been boiled*, has a sharp acid taste, and is greedily eaten by the cattle. The pits should be kept covered for at least six weeks, after which they may be opened successively as they are required, and may be kept open till their contents are consumed by the cattle without suffering any injury from the contact of the atmospheric air. Of the feeding qualities of this salted fodder, one experimenter says that, by giving only 20 lbs. a day of it, along with chopped straw, he kept his cows in condition during the whole winter. His green crop was vetches, and the twenty pounds of salted fodder were equal to or would have made less than four pounds of vetch hay. Another experimenter says that on a daily allowance of 28 lbs. of his salted fodder his cows gave a rich and well-tasted milk.

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lation of the passage is given in Stevens's large work, 'The Farmer's Guide,' which appeared in 1851." The fact is that Professor Johnston obtained some, at least, of his information from the 'Transactions of the Baltic Society for the promotion of Agriculture,' published at Greifswald in 1842. An extract from his article was published in Stephens's 'Book of the Farm,' First Edition, vol. iii. p. 978, published in 1844, and in the edition of 1871, in vol. ii. p. 216.

* To preserve the feeding properties of grass more completely than by the process of haymaking.

"This method of salting and preserving green crops in their moist state appears to afford an answer to the first question which is naturally asked when we are told of the difference in feeding-value between the same grass when first cut and when dried into hay. It is probable that the fermentation which takes place in the pit may in some degree diminish the nutritive value of the grass, but the likelihood which exists that a very large proportion of this value will be retained renders the method of salting in this manner well worthy the attention of our more skilful agriculturists. It would greatly benefit both theory and practice also were careful series of experiments to be made in different localities, with the view of determining the true relative value in feeding of stock of the grass of the same field when newly cut and when salted and preserved in the manner above described."

I should add that a much longer extract from Mr. Johnston's paper appeared in the 'Farmer's Gazette' (Dublin) for January 26th, 1884. Professor Wrightson also gave a brief notice of the manner in which sour grass has for generations been preserved in Hungary, in his 'Report on the Agriculture of the Austro-Hungarian Empire,' published in this 'Journal' in 1874 (p. 351); but it attracted very little attention at the time.

However, in course of conversation last January with the Chairman of the Journal Committee (Earl Cathcart), at his place near Thirsk, his Lordship informed me that he possessed a "silo" several years old, and would have it found and opened, and send me what information he could about it, including an extract from the farm-bailiff's diary. The latter I give *verbatim et literatim*:—

Extract from Farm Diary.

"5 July, 1875.	All hands at Carr Field Hay—Put it into '*Cile.*'
12 ,, ,,	Cart leading Grass from Coach Road to make '*pickeled*' Hay.
13 ,, ,,	Finished leading Grass to make it into 'pickeled' Hay."

The agent of the estate (Mr. Mills) states that he recollects the silo being prepared, and heard the conversation on the subject; and Lord Cathcart adds, "The silage * was good, and will compare with that I have recently seen, except that it was more moist. I handled the stuff during the winter of 1875 or '76. The silo was dug out of lightish land, and the men say drained; anyway, there was a ditch near." The following further communications give the result of his reopening the silo in January this year:—"Some silage of 1875 found, sample kept, just left a pony eating some of it; black, gone, and wet.

* It will be observed that I have made my correspondents use my terms throughout this Report.

Will soon, I think, be bad, nasty. *The fibre and character of the grass all there, stalk and all,* but black with a slimy admixture, as though pond-mud. The grave, or silo, is wet—too wet. The original sin of the silo." Next day (January 29) his Lordship wrote:—"After writing to you yesterday I went to look, and the pony had eaten up the 1875 silage,—*a clean-licked manger.* I had mixed in the bucket of silage a handful or two of corn and bran."

The use of silos for the preservation of green fodder, other than "sour grass," appears to have been commenced in 1861 by Herr Reihlen, of Stuttgart, who first published an account of his procedure in a letter dated April 1862, and communicated to the Württemberg 'Wochenblatt.' This was followed by another letter from the same gentleman, dated September 23rd, 1865, and published in the same newspaper, in which the procedure employed from the commencement, as well as the results obtained, are further described. Translations of these letters and of some other documents were communicated by M. Vilmorin-Andrieux to the 'Journal d'Agriculture Pratique,' edited by my friend M. Lecouteux, an honorary member of this Society, and were published therein in the numbers which appeared on June 23rd, July 7th, and July 14th, 1870. This was the real commencement of the practice of ensilage for the preservation of green fodder for winter use in France; and therefore it will be desirable to give a short notice of what M. Reihlen actually did so long as twenty years ago, especially as English and American writers have generally ignored the name and the services of this original adapter of the old process for the preservation of grass and grain.*

It is always interesting to learn the motives or necessities which have led up to inventions, and fortunately in this case the information is quite definite, both as to the original conception by M. Reihlen and the subsequent adoption by French farmers. It is well known that in Germany most large farmers grow extensive areas of sugar-beet, and that the leaves of the plants are used as green fodder in the autumn. The oxen, which will be fattened on beetroot-pulp during the winter are

* Most English writers on ensilage during the last two years have followed several American authors in saying that M. Goffart made his first experiment on ensilage with Indian corn, in 1852. This is a mistake. What M. Goffart says is that in 1852 he began to study practically the important problem of the preservation of forage ("C'est à Burtin que, dès 1852, j'ai commencé à étudier pratiquement l'important problème de la conservation des fourrages"). He also states (p. 185, 4th Edition), that until 1873 he had scarcely believed in the possibility of preserving green maize, but in that year he was very successful, chiefly by accident, and he gives (p. 186) the following statement of what he heard his foreman say to the workpeople:—"M. Goffart nous fait faire là une sotte besogne; il ferait bien mieux de jeter, tout de suite, son maïs sur le fumier, il faudra toujours qu'il finisse par là."

employed in the autumn as draught animals, and then require concentrated and very nourishing food. The beetroot-leaves must therefore be used wastefully in autumn, or altogether wasted without use, unless they can be preserved for mixture with other food in the winter, when the cattle are in the stalls. This is the explanation which M. Reihlen gave in 1862 for his first attempt at preserving green food in silos,* and he stated that he preserved in a dozen silos, each from 5 to 6 feet deep, the leaves and collars of beetroots off about 400 acres. Although the experiment was a new one, it succeeded perfectly, and led Herr Reihlen to develop the system. He had travelled in America, and had attempted the cultivation of maize; but in the climate of Württemberg he found that the grain did not always ripen, and that the stalks were difficult to be utilised. Therefore he tried the preservation in silos of the maize, both green and ripe, with and without the cobs, and both alone and mixed with beetroot-pulp. His success was so great, that when M. Vilmorin-Andrieux wrote in 1870, Herr Reihlen was in the habit of filling each year silos having a total length of three-fifths of a mile, a depth of 10 feet, and a width at the top of about 15 feet, slightly tapering downwards.

The original article in the French 'Journal d'Agriculture Pratique' of June 23rd, 1870, in which M. Vilmorin-Andrieux called the attention of French farmers to the process of ensilage as practised by Herr Reihlen, is headed "*La sécheresse et les fourrages.*" In fact, it was the abnormally *dry* season of that year which forced the system upon the attention of French agriculturists. This is not a little curious when we remember that the moving force with us has been a succession of *wet* seasons, which have rendered haymaking almost impossible in some localities.

It must not be forgotten, however, that in 1867, Count Roederer, a well-known agriculturist and breeder of thoroughbred horses, living at Bois-Roussel, in the Department of the Orne, began to preserve green maize in silos for winter use by chopping it and mixing it with cut straw and oat-cavings. This method of procedure he described briefly in a letter dated June 18th, 1870, and addressed to the editor of the 'Journal d'Agriculture Progressive,' who published it the following week. It is also stated on the authority of M. Bella, in his report to the "Société Nationale d'Agriculture de France," presented in April 1875, and republished in M. Goffart's own book (4th edition, p. 122), that M. Moreul, of La Grignonnière, had, since 1870, used the system of ensilage for the preservation of unchopped, but salted, maize with great success.

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* *Vide* 'Journal d'Agriculture pratique,' July 7, 1870, p. 10.

Although all these agriculturists were in advance of M. Goffart as regards the practice of ensilage, it must always be acknowledged that the chief merit of M. Goffart is that he was the first to describe practically, as he did in the first edition of his well-known book,* which was published in 1877, the complete details of the process of ensilage, especially with reference to green maize. It is by no means his fault if he has been mistranslated by his American admirers. The records of diplomacy show that the politicians of the United States have been especially liable to mistakes in the translation of foreign languages, and it is not surprising that American agriculturists still retain the same foible. They have made him claim a priority which he has not claimed for himself. The real fact is summed up by the reporter of the Section of "Grande Culture" of the "*Société Nationale d'Agriculture de France*," when, in the name of that Section, on June 19th, 1883, he recommended that M. Goffart should be awarded the highest distinction which the Society could give, namely, an Object of Art, as an "*acte de bonne justice en récompensant un agriculteur qui a tant contribué à répandre la meilleure méthode d'ensilage*," and again, "*pour les services importants qui'l a rendus à l'agriculture en vulgarisant les meilleurs procédés d'ensilage et de conservation du maïs fourrage.*" †

Practice.

In order to obtain authentic statements of the experiences of those who had already attempted the system of ensilage for British fodder crops, I issued the following list of questions to a large number of English and a few foreign agriculturists :—

List of Questions.

1. What are the dimensions of your silo?
2. Is it above or below the level of the soil?
3. How is it constructed, especially as to materials? And have you made any experiments with silos not covered by a durable or permanent roof?
4. What was its first cost, and how long do you expect it to last?
5. When did you fill your silo?
6. If not yet filled, when do you propose to fill it?
7. What crop or crops do you preserve by the process of ensilage?
8. In what state do you use them, viz., unripe, ripe, or over-ripe?
9. Are the crops pitted in a whole or chopped state?
10. If in a chopped state, what is the average length of the cuttings?
11. Do you mix with the main substance, or crop, any other material; for instance, straw, or salt, and if so, why?
12. Is the silo filled at one operation as quickly as possible, or are intervals

* 'Manuel de la Culture et de l'Ensilage des Maïs et autres fourrages verts.' Par Auguste Goffart.

† 'Goffart,' 4th Edition, p. 260.

left to allow the first portions of material to settle before the process is renewed?

13. Please give details with reasons for your mode of procedure?

14. In what manner do you compress the material placed in the silo?

15. If any mechanical contrivance is used, what amount of pressure is applied, how long is it continued, and why is this mode preferred?

16. What was the weight of the crops put into the silo, and please record the weight of the preserved material when taken out fit for use?

17. What is the expense in labour of filling the silo, and the expense in labour and materials of compressing, covering, &c., the contents?

18. What is the cost of emptying the silo? How is this operation performed? For instance, do you take the material off in layers from the top, or do you cut it down vertically like hay in a stack?

19. What definite results have you obtained by this method of pitting fodder crops?

20. Have you found any result specially attributable to succulence of the crops, or to external moisture upon them before being pitted?

21. Can the fodder preserved by you in silos be consumed without deterioration if taken out by degrees during a period extending over several months, or must it be rapidly consumed after the contents of the silo have been once cut?

22. What, in your opinion, is the reason why pitted fodder sometimes keeps free from mould and wholesome for several months after the silo has been opened; and at other times does not keep sound even for a few days?

23. Please add a general statement of your experience, especially with regard to the use of pitted fodder as food for stock, whether alone or in conjunction with other feeding materials.

H. M. JENKINS, *Secretary.*

N.B.—If you have a fair sample of what was put into your silo I should be glad to receive a portion of it for Examination, and possibly for Analysis.

In the following pages I give details furnished me by more than forty correspondents, of whom six are foreign * and the remainder British. A perusal of these records of practice will show how widely divergent are the methods pursued, and my notes will show how different in many cases are the results obtained. To facilitate reference I have adopted the following classification of the replies:—

I. Silo without roof.
II. Roofed Silos with Portable weights.
  A. Silage Unchopped.
  B. Silage partly Chopped.
  C. Silage entirely Chopped.
III. Silos with Mechanical means of Compression.
IV. Foreign Silos.
  A. France.
  B. The Netherlands.

Under each of these headings I have given the answers to the

* I have avoided giving any details of American practice in consequence of differences in climate rendering them an uncertain guide to English farmers.

questions in the alphabetical order of the names of my correspondents, except in the two or three cases where the replies were received too late to be inserted in their proper places. Some readers may think that I have rather overwhelmed them with records of practice, but in a subject so new I felt that this was an error on the right side, and would at any rate screen me from any charge of bias or partiality. I have added descriptions and illustrations of two machines for cutting and elevating materials to be preserved in silos, one being English and the other French.

I wish to thank all my correspondents for the trouble they have taken for the purpose of this Report, and also the many owners of silos who have received me, and sometimes large parties of agriculturists, on visits of inspection. On these occasions the most searching questions were readily answered, and the most ravenous appetites generously appeased!

I.—Silo without Roof.

Mr. G. Hopkins, The Hayes, Cardiff.—My silo is 30 feet long, 15 feet wide, and 9 feet deep. It is two-thirds below the level of the soil, and one-third above it. The walls above ground are of 9-inch brickwork; and the sides and bottom below the level of the land have a 2½-inch brick casing cemented with waterproof Cardiff lime. The bulk of the material put in was chaffed grass, but after it had sunk below the level of the top, 4 loads of long grass were added, and in a few days afterwards 1 load of green comfrey and 5 cwts. of bran on the top. The whole was then battened down with boards cut to fit the inside of the silo. Excavated earth from the locality of the silo was then thrown on the boards, and this was the only covering. All this was done in July, 1883. I consider that the silo will last a lifetime. Its cost was 15*l.*

The grass had been cut for hay in the usual way, but as heavy rain came on, I decided to try ensilage. Three-fourths of it was chopped into half-inch lengths by a 5-horse-power engine in two days, and was mixed with half a ton of salt,* as I thought it would prevent combustion and fermentation. In the course of a week the mass shrunk to the extent of one-third, and the long grass and then the bran were added. The total weight of the material I estimate at 50 tons, the produce of 10 acres, and, weather permitting, would have made 12 tons of hay, valued at about 40*l.* It was compressed as the silo was filled by a horse walking round upon it. The cost of filling was as follows:—

	£	*s.*	*d.*
Steam-engine 2 days, with attendant	2	10	0
2 men and 2 women for 2 days feeding, clearing away, and spreading	1	0	0
5 cwts. bran spread over all	1	10	0
Labour, placing boards on the bran	0	5	0
Labour for covering with earth	0	7	0
	£5	12	0

* Mr. Hopkins now considers this quantity of salt too great, and suggests that one-fifth, viz. 2 cwt., would be sufficient.

In fine weather it would have cost 6*l.* to make the hay, but 12*l.* under unfavourable circumstances.

The cost of mowing is 5*s.* 6*d.* per acre, and the cost of carting the grass and pitching it into the silo is estimated at 5*s.* per ton. Pitting and treading cost 15*s.* per day.

This silo, unique in my experience, besides being uncovered, and two-thirds below the level of the soil, is situated near a brook, the swollen waters from which penetrated through the thin brick and cement wall, while the autumn rains completely soaked the covering of earth and the silage immediately beneath it. Therefore only a comparatively thin layer between the top and the bottom was in a fair state of preservation when I saw it opened last November, the remainder being fit only for manure.

II.—Roofed Silos with Portable Weights.

A. Silage Unchopped.

1. *Mr. A. Copley (per Mr. T. Easdale), East Cowton, Northallerton.*—The original silo was 12 feet long, 7 feet wide, and 8 feet deep, but it is now 2 feet deeper. A second silo, built this year, is 15 feet long, 7 feet wide, and 10 feet deep. Both are 8 feet below and 2 feet above the level of the ground. The first silo was built of bricks and mortar, faced with 1 inch of cement lining, and was covered for one year with a low movable span roof. The second one was built of concrete, faced with ¼-inch of cement lining. The cost was the same as that of any oblong pit or water-tank of the same dimensions, and the silos will last for many years. Filling is done at various times, when the crops are ready and other things convenient, but we endeavour to catch the material at that stage of growth when it contains most nutriment. Meadow-grass, aftermath, comfrey, oats, tares, and clover have been pitted, all in a whole state. The filling will be completed in September. A small sprinkling of salt has been added—but not more than 1 lb. to 2½ cwts. of grass, &c.—with the idea of destroying noxious life-germs, such as liver-fluke, &c. The material is covered with transverse boards, 2 inches thick, and weighted with iron blocks of 1 cwt. each, so as to give a pressure of 1½ cwt. per square foot. As to the weight of the preserved material, it may be stated that in December, 1882, one cubic foot was taken out of the original silo and found to weigh 43½ lbs., after a pressure of only 100 lbs. per square foot. The cost of filling the silo is the ordinary cost of cutting and carting home green fodder of any kind, *plus* that of casting it into the pit and spreading and treading it well. The expense of compression depends entirely on the material used, and whether with an idea of permanency or otherwise. The contents of the original silo were cut down vertically, like a haystack, and the cost of emptying it was the same as that of cutting down a haystack for the use of cattle. The effect of using the pitted fodder has been that the milch cows improved in condition, and the yield of milk, cream, and butter increased in quantity and improved in quality. Each cow received in previous years daily 2 lbs. of oats, 10 lbs. of hay, and 45 lbs. of pitted fodder, but this year the use of hay has been discontinued. The fodder can be consumed without deterioration, if taken out by degrees, during a period extending over several months.

Mr. Copley is a pioneer in the question of ensilage, and

therefore it is desirable to give a little explanation of his experiments, although they have been conducted on only a small scale. Mr. Copley farms about 15 or 20 acres of his own land with his own hands as an amusement. He keeps four cows, and I should not be surprised to learn at any moment that he had become his own dairyman. In 1882 he built the first silo, and he was so far satisfied with the result, that in 1883 he built a second, as he has described above. The two are placed in what may be called a small barn, and they receive contributions from the highways and byways, hedges and ditches, churchyards and meadows. Notwithstanding that in 1882 the fragrancy of the fodder was almost too powerful for delicate organisations, Mr. Copley's example was followed by Mr. Stobart, Mr. Ford, and others in the district; but of course with certain variations. All the motley mass collected by Mr. Copley is put in long—thistles and nettles, prickly comfrey, the haulm of Jerusalem artichokes, as well as the ordinary agricultural crops mentioned by Mr. Copley himself. The weights are raised and lowered by means of a chain and pulley, which arrangement is also used to hoist out the silage. As to the result, I must confess that the fodder was more than sufficiently fragrant at the time of my first visit, on August 21, 1883, and its odour was still more pronounced on January 21, 1884. Nevertheless, Mr. Copley was perfectly satisfied, as his cows ate readily as much as 84 lbs. of it per diem, and gave an abundant flow of milk, the butter from which was stated to be of excellent quality.

2. *Darlington Sewage Farm, per Mr. J. Burnside.*—Our silo is 17 feet by 17 feet, and is above the level of the ground. It is an old brick building, and was formerly used as a cow-barn. The walls are cemented round to their full height, and there is likewise a good cemented floor, with good walls 18 inches thick. The cost of preparing the silo would be 30*l.*, the weights and planks about 45*l.* additional.

The silo was filled the first week in August with meadow-grass, mown when ripe, and put in whole, with a little salt at intervals.

This is our first year of trial. I shall be glad to give you more particulars after proving the feeding-quality of the silage.

The material is compressed with metal weights. It consisted of **7** acres of meadow-grass in a very dry state, weighing **31** tons, and put in the day it was cut. The cost of cutting, raking up, carting, strewing it well about in the silo, men's beer, getting the weights on and off, then on again, with the planks, cost me 6*l.*

The pitted fodder is cut down in the same manner as hay. I cannot see why it will not keep several months, if you only take the weights off as you use the fodder.—*Jan. 25th,* 1884.

I visited this silo on January 22, when it was specially opened for my inspection. It may be necessary to state that, although the silo was on a sewage farm, the grass which had

been ensilaged had not been sewaged. Mr. Burnside, indeed, told me that its quality was remarkably good, and certainly the result was excellent. Although the weights put on gave a pressure of $1\frac{1}{2}$ cwt. to the square foot, no liquid had been pressed out; but it must be remembered that the grass was in a very dry state when it was put into the silo. There was a certain amount of mouldy silage at the sides, and especially near the doorway.

3. *Rev. C. H. Ford, Bishopton, Ferry Hill, Durham.*—My silo is 15 feet long, 8 feet wide, and 9 feet deep, viz. 5 feet below ground and 4 feet above. The floor is composed of the best concrete, 12 inches in thickness. The walls below ground resting on the floor, being 15 inches thick of concrete, above ground they are of brick. The whole is thoroughly well lined and finished off with cement, the floor having no less than 4 inches of the best quality. In spite of these precautions, the water, by capillary attraction, pierced concrete and cement, and several inches thereof stood on the floor. I sunk a well, 6 feet deeper than the silo, broke up the floor with infinite labour, and drained it thoroughly into the well, recementing the floor over the drains. This has kept the outside water from coming in, but, strange to say, the ensilage liquor finds its way into the drains, and renders the well water unfit for use.

My soil is tenacious clay. On July 5 I filled the silo up to the top, 9 feet. It took 14 single horse-loads, estimated at 10 cwts. each, or 7 tons; next morning the mass, under a pressure of 6 tons, had sunk 3 feet; by July 9 it had sunk 4 feet. *July* 12.—Filled up silo again with 8 loads of grass estimated to weigh 4 tons. Put on 10 tons dead-weight of iron waste.

The actual cost of labour in cutting and putting $1\frac{1}{2}$ acres of grass into silo, including taking off 6 tons of weight and putting on 10 tons, was 11*s*. I pay my men 3*s*. per diem each; the use of horses is not charged for.

July 23.—Filled silo again. The mass had sunk 4 feet. Put in 3 tons of grass, covered up with 10 tons weight. This grass was off a much poorer field, and so the crop was poor, though of fair quality. It came off $1\frac{1}{2}$ acres, and the cost of cutting, loading, and putting into silo, and putting weights off and on, was 10*s*. 10*d*., or 7*s*. per acre.

August 20.—I had now only 2 feet 4 to fill up, and it was probably not worth the expense, commercially, but I wished to have it as full as possible. Mr. Jenkins came from London to witness this operation. I put in 3 tons of clover, second crop, and covered up with 12 tons of dead weight.

August 30.—I opened the silo again and had only 15 inches to fill up. I filled up with nearly 3 tons of second-crop clover, and had it well trodden by six pairs of human legs; covered up with 12 tons.

November 13.—I opened the silo and found that it had sunk nearly 2 feet from the top. Mr. Jenkins will report on it, so it will be unnecessary for me to say more than that the silage was excellent, no waste; but he thought, and I agreed with him, that the pressure might have been much less for the clover.

I did not cut the old-land grass into chaff, nor the clover. I used no bran and no salt. The young stock are doing remarkably well on this food and hay.

I tried the following experiment with three cows, which calved respectively May 8, June 3, and September 10, two of them being heifers with one calf, the other having had two calves.

On November 13, before the silo was opened, I had the milk of these three cows analysed. It was pronounced to be "fair average country milk." They were then going into the pasture, and getting hay and pollard.

November 20.—They had all taken to the new food, and the measurement of the milk, to my astonishment, showed a decrease in the quantity. The butter was excellent in flavour and taste, with a marked improvement in both. They were eating good hay and pollard. The analysis showed a decided improvement in fatty matter.

From December 10 to 17 they were fed on silage and cotton-cake only; no waste was allowed. The quantity of milk was maintained, but not increased. The analysis again showed an improvement in fatty matter, and the quality was also improved.

From December 17 to 31 they were fed on hay, mangolds, and cake, and no silage. The quantity of milk was still maintained, but the analysis showed an increase of one-fourth in the fat.

The result of this experiment, to my mind, has been that the virtue of silage has been demonstrated, not, as I expected, by the increase of quantity, but by *maintaining* the quantity during that period of the year when one would expect it to diminish, by improving the quality to a considerable extent, and by keeping the animals fed upon it, old and young, in good blooming health and condition. The economy of this food is apparent.

N.B.—My weights, which cost me nothing, are removed by hand every time. I have filled my silo five times, at a cost of putting on and off of 1*s*. 4*d*. each way; the cost therefore of removing weights and putting them on is 13*s*. 4*d*. for the season. Can any one show a less costly mode of weighting? Certainly not a more effectual.

When I first visited this silo, on August 20, 1883, I saw the boards removed from the top of the material which had been previously pitted. The uppermost layer of mouldy grass was first taken off, and then a square mass about a foot in depth was taken out. It had an acid and somewhat vinous smell, but at least six inches in depth of the upper part was sandwiched with layers of mould, which Mr. Ford was at a loss to account for. It seemed to me that the weights, as in some other silos in the district, had been piled on too liberally (200 lbs. per square foot), and caused the juice to be expressed out of the silo, and thus contaminated the well, as described above by Mr. Ford. Notwithstanding this drainage, a sample of silage received on December 5, 1883, was found to contain 73·7 per cent. of moisture, and it went rapidly mouldy.

At the time of my first visit the silo was being filled up for the fourth time with second-cut clover. The treading of it seemed here, as elsewhere, a tedious process, but as many of the "treaders" were volunteers, it was perhaps not quite effectual, and the cost cannot be given.

The construction of the roof, the eaves of which came close down to a wooden cap on the top of the brickwork of the silo, was worth noting. The roof is ridged, each slope being formed of tarred and felted doors, which are hinged, and shut down upon movable rafters fitting into slots in the ridge, and in the wooden cap to the brickwork. Although Mr. Ford puts the total cost at 40*l*., it may be said on the one hand that this does

not cover all the adjuncts, and on the other that the cost was greatly increased by the drainage difficulties. In fact, as the bricks and some other materials were presented to Mr. Ford for the purpose of this experiment, it is not possible to enter into minute calculations of cost. Then, as regards the cost of filling, Mr. Ford is so enthusiastic that he himself sits on the mowing-machine, and does not charge anything in his accounts for his own time. With the low roof of this silo, the crane is a very valuable means of economizing labour in putting the weights on and taking them off, as well as in lifting the silage out of the silo.

On January 23rd, 1884, I again visited this silo, to see the result of Mr. Ford's experiment. Notwithstanding the persistent infiltration of drainage from the silo into the well, the silage was very good in parts. The grass was the best; but the clover, which had been probably put in when more succulent and wet, had been squeezed into a kind of paste. Mr. Ford quite admitted the fact, and also the lesson to be derived from it, namely, that the pressure should be altered according to the nature of the crop to be preserved and its condition when pitted.

It should be added that Mr. Ford farms a glebe of about 60 acres, and that this is his first year's experience.

4. *Mr. Arthur H. Grant, Abbotswood, Romsey, Hants.*—I have five pits of the following dimensions: No. 1, 6 feet long, 6 feet wide, and 6 feet deep; Nos. 2 and 3, each 11 feet long, 15 feet wide, and 10 feet deep; No. 4, 15 feet long, 16 feet wide, and 12 feet deep; and No. 5, 15 feet long, 16 feet wide, and 10 feet deep. They are all below the level of the soil. No. 4 pit is built of 9-inch brickwork, run over very thinly with cement; the others are made of 4½-inch brickwork, and between two pits I have a 9-inch partition-wall. The roofs are of corrugated iron, with the exception of one silo, which is roofed with Willesden paper. Incidentally I would mention that I prefer iron to this paper, as it requires far less wood, although what is used must be slightly stouter; there is also far less carpenters' work to be done. On the other hand, over cattle, &c., iron always condenses the moisture of a shed, and a drip follows; this, I think, is not the case with paper. The first cost of these silos is unknown, as the gravel, &c., dug out was used for concrete building, roads, &c., and many of the bricks used were old.

The first filling took place in May and the second in July, with vetches and oats, meadow-grass, *Trifolium incarnatum*, and "seeds," consisting of Italian rye-grass and hop-clover. All the crops were put in uncut and not quite ripe—the vetches when just coming into flower. No substance was mixed with them, but I once tried bran without any visible effect. Each silo is filled to, say, 4 feet above the top of the walls, as quickly as possible; the crop is then weighted and allowed to sink one or two nights, then refilled to the 4 feet again and closed for two months, when the second or later crops are cut. The silo is then opened and filled twice to 4 feet above the surface again, and then closed until opened for use in winter. The 4 feet is named because my weights, being concrete blocks, build up easily to a height of 4 feet, thus giving an additional depth. When the silo is quite full, these

blocks can be rolled on to the boards; as the stuff sinks, row after row is placed on the boards. The concrete blocks are 9 inches by 9 inches by 12 inches, or 9 inches by 9 inches by 18 inches; and in addition I use as weighting materials bricks, loose earth, logs of wood, &c. I use at least 1 cwt. per superficial foot, and often 2 to 2½ cwts., and in the corners 3 to 4 cwts., and I leave the weights on until I require the forage.

In 1881 I put about 6 tons of fodder into a silo; in 1882 I put in 60 tons, and in 1883 no less than 200 tons. I think the same weight comes out as you put in, for where is the weight to go? There is no evaporation to speak of, and no loss by drainage. One cubic foot of pitted fodder weighs about 50 lbs. The cost of cutting the crops by machine, carrying, pitting, compressing, covering, &c., is about 7*s.* 6*d.* per acre. The following is a statement of the cost of saving a second cut of "seeds" off 10½ acres—the crop being a light one, which would have made, say, half a ton of hay per acre:—

	£	*s.*	*d.*
Time of 12 men at 4*s.* 6*d.*, to include extra hours, beer, &c.	2	14	0
„ 7 horses at 2*s.* (cost price to the farmer)	0	14	0
Extra work, piling on weights, &c., next day, say	0	6	0
Total	£3	14	0

The crop was cut, carried, and pitted between 8 A.M. and 8 P.M. The cost of emptying the silo is merely that of cutting out of a hayrick, *minus* the expense of tying the bands of the trusses. I cut down vertically (in from 1 foot to 1 foot 6 inch slices) like hay in a stack.

With regard to the results obtained, I may state that I once was feeding 3 Jersey cows as follows:—2 lbs. oilcake and 1 gall. crushed oats as extra food, with hay *ad libitum.* On half-gall. crushed oats and about half-cwt. "silage" made from seeds, the butter increased as from 100 to 125. I once cut and carried 5 acres of meadow-grass purposely in *pouring* rain. When I cut it out I stated in the *Field* that it came out as good as that carried dry. I afterwards modified that opinion. It was blacker in colour than that carried dry, and the cattle ate up every bit of it; but the cows in full milk preferred other food, and I gave it chiefly to dry stock and pigs. I once purposely left a vertical slice in a silo open (whilst consuming a field of cabbage) for about three weeks or a month. At the end of that time white mould appeared on the face of the slice, and it penetrated about two or three inches horizontally into the stuff. My silos having partition walls, the contents of one division last my cows only a few weeks, and this I prefer to a very long silo, for economic reasons in the filling—it being much easier to fill two pits 15 feet long each than one pit 30 feet long. My ensilaged fodder always keeps good several days, and if allowed to dry in small quantities it becomes very like good hay.

With three years' experience I fully approve of the use of pitted fodder as food for stock, and shall largely increase my silos every year, to the utmost capacity of my land to grow green crops, such as vetches and oats, both winter and spring (especially winter vetches), and similar bulky green crops. I am thinking of buckwheat—to be pitted green—as a quick-growing summer crop suited to poor gravels. In my opinion, "silage" requires an addition of some food, such as crushed oats (i.e. nitrogenous food). I further think that summer dairymen might, as in the Sologne, in France, guard against dry summers, if we ever get any more, by pitting a large acreage of rye, winter vetches, *Trifolium incarnatum*, &c., say in May. Their land would then give a turnip crop, and the "silage," if not wanted for summer use, would be ready for the following winter. "Ensilage" is good—very good indeed—as a system, but it is not an easy and universal mode of worldly salvation to the farmer; and it demands common sense, care, and attention, but it saves in money, time, and anxiety.—*February 8th,* 1883.

5. *Mr. W. J. Harris, Halwill Manor, Highampton, Devon.*—The dimensions of my silo are 35 feet in length, 18 in width, and 10½ in depth. It is 2 feet below the ground at one end, and 6 feet at the other. It consists of a strong stone wall cemented at the sides and bottom, and covered with a slate roof. The first cost was £110, and practically it will last for ever. The first filling was done between the 9th and the 16th of July, and the second at the end of September, the materials used being in the first instance meadow-grass and clover and rye-grass, and afterwards second-cut clover. The crops are cut when approaching ripeness, and are put into the silo without being chaffed. I mixed a little salt with a portion, but I think it is no better than the rest which had no salt mixed with it. The contents of the silo were pressed down as much as could be conveniently done every time that a day's filling took place, so as to get rid of all atmospheric air as quickly as possible. The pitted fodder is covered with chaff, then with 3-inch boards afterwards a layer of sand 15 inches deep, as well as some iron rails, and now I am storing turnips on the top. At present I have no mechanical appliance for weighting, but I hope to invent one. The weight of the crops put into the silo was about 80 tons, and I think the same quantity was there when I opened it on November 12th. The quality of the pitted fodder is excellent; the cows prefer it to any other food, and horses leave oats for it. I should judge that it costs about the same between cutting and storing as a haystack costs; that is to say, if the field is not far from the silo. My 80 tons were carried in 87 waggon-loads. The pitted material now weighs 40 lbs. per cubic foot, and I value 5 tons of it as equal to 2 tons of good hay. The 80 tons came off 9 acres, which would have produced about 20 tons of hay.—*December 10th*, 1883.

6. *Mr. C. R. Kenyon, Brynllwydwyn, Machynlleth.*—The dimensions of my silo are as follows: length, 11 ft. 9 in.; width, 10 ft.; and depth, 11 ft. It is below the level of the soil. It was constructed in the following manner: A large and deep pit was first excavated near the edge of a bank, which dipped abruptly down to a stream below; facing walls were then built of common bricks set in cement, and were made perfectly rectangular and perpendicular, to permit the lid to move freely downwards as the contents subsided. To guard against the influx of water, a drain was carried from the foundation of the silo to the stream, and the floor itself was constructed of flags laid on mortar, and joined together with cement. At each of the four corners the brickwork was continued upwards in the form of pillars to support a light roof. This was made sufficiently high to form a sort of Dutch barn for the storage of hay, &c., as well as a cover to the silo. The first cost of this silo in labour and materials was about 35*l.* 10*s.*, and I expect it to last as long as any other building on the farm.

Last year (1882), by way of experiment, I had a trench excavated, about 9 ft. long by 4 ft. wide and 5 ft. deep, in a dry gravelly soil. This was filled with uncut grass, well trodden down, and filled up to the height of about 4 ft. above the surface of the ground. It was covered by the soil taken from the pit being piled, roof-shape, upon it; but in consequence of the great subsidence of the grass the whole sank below the surface of the ground. The result was that the rain-water got in, and the grass was spoiled.

The silo proper was first filled between September 24th and October 4th, 1881; and in 1882 it was also filled twice—the first week in September, and the first week in October. This year (1883) it was filled in July and September. Grass is almost the only crop I preserve by ensilage, and it has generally happened that the crop has been over-ripe at the time we have found it convenient to pit it, but I should prefer to do so when the majority of the grasses are in flower. The first two years I passed all the grass through a chaff-cutter driven by water-power, before throwing it into the pit, the

average length of the cuttings being about one inch. The first year I mixed a little salt with the cut grass, as it was thrown into the silo. The second year I only did so with about half the contents of the pit, and this year I have not used any admixture whatever, as the salt seemed to make no difference either as regards the preservation of the material or its feeding properties. I have generally filled my silo at the rate of from four to eight loads a day. When I am unable to cram any more stuff into it I put on the lids and weights, and leave it to settle for a month or two, after which it is again filled to the top, and then finally covered and weighted down, until the contents are required for the use of the stock.

My present silo being only large enough to contain a small proportion of the crop of meadow-grass, the new process is with me, of course, merely subsidiary to the older and, as yet at least, more important one of hay-making. It is therefore my plan to economise time and labour by setting the men to pit grass whenever the weather is such as to prevent or put a stop to the other mode of harvesting. A two-horse mower soon cuts down a sufficient quantity of the grass which has been reserved in the vicinity of the silo; it is then thrown together with forks, or collected into rows with a horse-rake, and at once carted away to the pit. Here it is spread evenly about, and well trodden down by a couple of men, or more generally by a strong woman and three or four boys, an extra trampling being given by the whole force of men before leaving off or resuming work, morning, noon, and evening. It is quite unnecessary to put on the lid, &c., until the pit is full, unless the process of filling has to be discontinued, for any cause, for more than twenty-four hours. Six or eight days after, the lid and weights are put on, either finally, or in order that the contents may be left to settle down for a few weeks before adding more forage. I have found it advantageous to seal the edges of the lid or platform so as to prevent the entrance of air. This is easily done by simply building up the weighting material plumb, with but a little distance (say three or four inches) from the walls of the silo, and filling up the narrow space thus formed to a depth of eight or ten inches, with fine dry soil or sawdust. If this is not done, and especially if the forage is insufficiently weighted, mouldiness will make its appearance around the sides and on the top of the fodder to a greater or less extent. The weights consist of hard boulder stones taken from the bed of a mountain torrent, and also brickbats, the whole amounting to about 70 lbs. or 80 lbs. to the square foot.

I have not kept any exact record of the weight of the grass ensilaged, but should estimate it at twenty-five tons each year. I should say that the process entails little or no loss of weight, as the material is very moist and heavy when taken out for the use of the stock. If the grass is chaffed before being put into the silo, the expense in labour is about 2*s.* 10*d.* per ton, and 2*s.* per ton when it is pitted long as it comes from the meadow. These prices include mowing, carting, pitting, weighting, and everything, and no doubt they might be considerably reduced if the operations were carried out on a larger scale. The cost of the lid or cover is included in the amount already specified for the silo itself. It will also have been seen that little or no outlay has been required for weighting materials; in fact, anything that comes most handy may be pressed into the service; and, once the materials provided, the expense in labour of placing or removing them is quite inappreciable, being at the rate of not more than 3*d.* or 4*d.* a ton on each occasion.

If the silo is conveniently situated, the cost of emptying it and of supplying the contents to cattle is at least no greater than would be the case in feeding the same quantity of stock by the ordinary methods. As regards the manner of emptying the pit, I have tried both methods (viz. of taking the material off in layers from the top, and of cutting it down vertically), but I shall require to make still further experiments in the same direction before venturing to

give a decided opinion on this important point. I have reason to think that after the pit has been once opened more care is required in using the pitted fodder which has been stored in a very wet condition, i.e. saturated with rain-water.

The results obtained—at least to the extent of the limited capacity of my silo—may be summed up as follows: (1) Comparative independence of the weather, enabling a luxuriant crop of grass or other forage to be expeditiously preserved without fear of deterioration from wet or other exposure. (2) A cheap and efficient substitute for roots, so far at least as cattle are concerned; sheep I have not found to take so kindly to "silage." (3) A wholesome change of diet, and one greatly relished by horned stock of every age. I have not given it to horses, but I have no doubt that unbroken animals and those used for slow work would thrive equally well upon it.

By careful management pitted fodder can be consumed without deterioration when taken out by degrees during a period extending over several months. To this end—in so damp a climate as ours—I would recommend either that the silo be constructed very long and narrow, or that it be divided into several small compartments (say of 4-inch brickwork). In the former case the "silage" is to be cut down vertically with a hay-knife, a narrow strip at once, the entire width of the pit, regulating the thickness of the slice by the number of mouths to be fed, so that each strip, from the top to the bottom of the pit, be consumed within four or five days; thus no part of the surface of the main bulk of fodder will be exposed for more than that length of time to the atmosphere. Or, by the second method, the whole of the cover and weights from one of the small compartments or sections may be removed at once, and the "silage" taken evenly off the top of the mass—a thin layer each day as required. The pit should of course be constructed wider or narrower, or the sections larger or smaller, as the case may be, according to the number of animals proposed to be fed upon the contents. I have no experience of pitted fodder not keeping sound "even for a few days" after opening the pit; but I believe it is more liable to turn mouldy when the latter is in a damp situation, or sunk below the surface of the soil.

With regard to my experience as to the use of pitted fodder as food for stock, I have found cattle of all ages and descriptions grow and thrive remarkably well upon it, even when made from the coarsest description of herbage, such as they would scarcely touch if presented to them in any other form—with the addition of about 2 lbs. of cake or meal each per diem, and one feed of hay or oat-straw. Or if the pitted fodder is composed of grass of good quality, store beasts will not require any "artificial," as it is called, in conjunction therewith, though I should still give a feed of hay or straw, merely for the sake of a little variety, which is always advantageous. In the case of milch-cows and fattening stock, the pitted fodder should also be supplemented by a few pounds of cake or meal, indeed it is essential for the latter description of stock. In conclusion, I believe that the system of ensilage is the most economical method of preserving forage crops that has yet been discovered. My own experience points unmistakably to the fact that a ton of grass preserved by ensilage will go as far in the maintenance of stock as (at a low estimate) would 25 cwt. of the same material if made into hay. I am also confirmed in the opinion, expressed more than a year ago, that it is by no means essential that the silo should be sunk below the level of the soil. In fact, to do so would, in the majority of cases, be only going to needless trouble and expense. Probably the most convenient form of silo (as regards filling and emptying) would be one partly above and partly below the surface of the ground, though any old barn or other substantial building might be converted into a silo at comparatively small cost, and answer the purpose well enough.—*October 24th,* 1883.

PS.—Since sending off my answers to your questions last October, I have again opened my silo, and I am glad to say that the results of the third experiment are most satisfactory. The well-preserved condition of the grass, and the evident relish with which it is being eaten by all kinds of stock, confirm me in the opinion that ensilage is a valuable and economical method of saving green fodder.

In this last experiment I made an important departure from my previous practice. I did not cut the grass into chaff, but carted it direct from the field to the pit. Here it was well tossed about, evenly spread, and trodden down in the ordinary way. No salt was used. The weather was wet, and consequently the grass also; yet, when the silo was opened on the first of this month (February) there was certainly not more than the usual amount of waste. The black and mouldy portion was confined to a shallow and narrow belt around the edges of the mass, just beneath the shutters, and did not extend over the whole of the surface. After getting down a little way the fodder was found to be in as good condition against the walls as it was elsewhere. It was slightly acid to the taste, and emitted that peculiar and undescribable fragrance which always distinguishes good "silage."

Besides showing the uselessness of cutting the grass into chaff, there is a circumstance in connection with my present experience, which is very gratifying. *Sheep eat the "silage" freely.* A small flock of Shropshire breeding ewes are supplied with a feed every evening, and generally clear it all up before morning. They are running on grass-land. Another lot of 30 ewe-lambs, also on grass, eat a cratch full, daily. If good hay is placed in one end of the cratch, and "silage" in the other, the latter will be consumed to the last mouthful almost before the hay is touched—at least by the *majority* of the lambs. A *few* animals in each lot still hold aloof, or only partake very sparingly of the pitted fodder. Horses seem to care less about it than other stock; nevertheless two young colts and a pony eat it with evident relish.

I have not kept any exact record of the cost of carting the crop from the field and completely pitting it; indeed it would not have been easy to do so, as the work was carried on very irregularly. Whenever the weather was good enough for harvest operations the process was discontinued, and the men's efforts directed to securing some field of hay or crop of oats, as the case might be. Thus, on some days, perhaps only a couple of loads of grass would be pitted. If the interruption was likely to extend over more than one day, the shutters were placed in position and loaded with a few stones or bricks, otherwise this precaution was dispensed with. In no case were the whole of the weights put on until the silo was full.

Even when carried out in the disjointed manner above mentioned, the whole cost of the operation would not exceed from 12*s.* to 14*s.* an acre, or, say, 2*s.* 6*d.* per ton of grass pitted. Besides, it must not be forgotten that the work was only carried on when other methods of harvesting were out of the question.

In conclusion, I may say that the more experience I have of ensilage the more I value it. It has merits which must eventually ensure its adoption over the greater portion of this kingdom. Neither landlord nor tenant can long afford to ignore or refuse to practise a system which bids fair to relieve the farmer of some of his greatest anxieties: by enabling him (1) to secure his forage crops, in good condition, even in the wettest seasons (when they are generally the most abundant). (2) To do this in the simplest and most economical manner. (3) To preserve their natural succulence; and thus, (4) to partially, if not entirely, dispense with the costly root-crop.—*February* 16*th*, 1884.

After the foregoing exhaustive statement, it is scarcely

necessary for me to add any remarks. I visited Mr. Kenyon on January 18th, and found that, in consequence of having lived formerly in the United States, he had been one of the first to adopt the system of ensilage in England, or, I ought to say, in Wales. In the wild hilly part of the country where Mr. Kenyon lives, the climate is very trying for the harvesting of either grass or grain, and therefore to be practically independent of sunshine is the height of happiness to farmers living in such a district. Mr. Kenyon estimates his pressure at only 70 lbs. to the square foot, and certainly the quality of his silage did not suggest to me that it was insufficient, although a sample sent me went rapidly mouldy on exposure to the air. The depth of the silo is temporarily increased by boards which fit into grooves in the pillars carrying the roof of the silo. These can be removed when the grass sinks to the level of the permanent walls. When the "Dutch Barn" is not used for storing hay, a certain quantity of bracken or other coarse fern is thrown over the stones with which the silo is weighted, so as to soak up any rain that may be drifted in. Mr. Kenyon grows gorse largely as a fodder-crop, sowing from 20 to 30 lbs. of seed per acre, and chopping the plant into one-eighth inch lengths before giving it to his live-stock.

7. *Mr. T. Kirby, Hook Farm, Bromley, Kent.*—My silo is 27 feet long, 8 feet wide, and 12 feet deep, being 6 feet above the level of the soil, and 6 feet below. It is built with 14-inch brickwork, and cement and sand in the proportions of three to one, and is roofed with galvanized iron. It first cost was 30*l.*, and I expect it to last thirty years. It was filled in May with ordinary pasture grass in a ripe state, and put in whole without any admixture of salt or other substance in the course of five days at two intervals. The grass was covered by a layer of straw 3 inches thick, then by 2½-inch deal boards, and 20 tons of stones. The weight of the pitted material was 50 tons, and that of the preserved material 49 tons. The cost of filling the silo was 4*s.* per ton, for mowing, carting to the silo, treading, compressing, &c. The silo was opened in August; the weights were taken off, deals removed, and then the straw (two men's time half a day each). The pitted fodder is taken off in layers about one inch per day, the average weight per inch being one cwt. I am satisfied that this method of pitting grass provides a cheap and useful fodder for cows. If the pitted fodder is taken off by degrees, a pit could be left open for six months, provided that a little is taken off the top every few days; but if left for 5 or 6 days it will begin to turn mouldy on the top, owing, in my opinion, to its not having been kept sufficiently air-tight and properly compressed. I do not consider the pitted fodder good enough for stock without some artificial food.—*October 20th*, 1883.

Mr. Kirby has since informed me that he is building some large silos, and expects to be busy filling them in May. He then proposes to keep an accurate account of all the expenses incurred.

8. *Lord Londesborough (per Mr. Thomas Young, Agent), Londesborough Park Farm.*—At Lord Londesborough's suggestion a silo was made in July last in the end of the barn; its dimensions are 13 feet long by 8 wide, and 10 feet 6 inches deep, calculated, when full, to hold about 15 tons of fodder. The cost of brickwork and cement was 12*l.* Arrangements were made to drain off any liquid from the silo, and a tap was carried through the wall to the outside of the barn; but this has in this instance proved unnecessary, as nothing has drained from the fodder since it was put in.

The silo was filled with grass from the 20th to the 30th of August, care being taken to have it stored dry, and well trodden down as it was put in; and the weights, consisting of pig-iron blocks (1 cwt. each), and boards (1½ in.) halved at the joints, carefully put on, and removed when next filled, and then replaced as before. The weight used on this silo was 8 tons, averaging about 1½ cwt. per square foot.

As each layer of grass was put into the silo, about 3 stone of salt was sprinkled over 1 ton of grass.

On the 17th of November last the silo was opened by Lord Londesborough, in the presence of a number of his tenantry from the Londesborough and Selby estates: the contents were found to be in a very satisfactory condition, with but little waste on the top. The cattle, pigs, and horses that had the silage given to them ate it readily.

Arrangements were made for an experiment to test the value of silage as a food for dairy-cows as compared with other food, and four cows were selected and tied up in the same house: and from the 1st to the 10th of January had—

18 lbs.	Hay.
3 ,,	Chopped Straw.
10 ,,	Ground oats.
14 ,,	Roots (Mangolds).
3 ,,	Cotton-cake.
48 lbs.	for each cow per day.

The milk being weighed after every meal, morning and evening, with a total result from the four cows of 1095 lbs. of milk for the ten days.

From the 11th of January to the 20th of January, the same cows had—

28 lbs.	Silage.
10 ,,	Ground oats.
14 ,,	Roots (Mangolds).
3 ,,	Cotton-cake.
55 lbs.	for each cow per day.

And a total weight of milk given by the four cows, at the end of the ten days, was 1116 lbs., showing an increase of 21 lbs. in favour of the silage. It was then thought better to do away with the roots altogether, as one of the cows was slightly purged, consequently, from the 21st to the 30th, the following food was given:—

10 lbs.	Ground oats.
3 ,,	Cotton-cake.
5 ,,	Maize-meal.
38 ,,	Silage.
56 lbs.	for each cow per day,

with very satisfactory results; in ten days 1133 lbs. milk was produced, 38 lbs. over the first ten days. One square foot of silage has been weighed, and found to average 31 lbs.—*January 25th*, 1884.

I visited this silo on the day when the above memorandum was prepared for me, and found the silage very good indeed.

9. *Mr. J. W. Lowe, Chapel-en-le-Frith, Derbyshire.*—My silo is 27 feet long, 17 feet wide, and 10 feet deep, and is above the level of the soil, the floor being part of the barn floor. It consists of the original stone walls of the barn, which were made of rubble stone. They have been made level and vertically straight by chisels and picks, and afterwards coated with cement; the first coat of cement plaster being rather coarse, and not containing so much cement as the finishing coat. Total thickness of cement lining, 1 inch. The total cost was about 50*l*. exclusive of pig-iron. The silo was filled in July last with meadow grass put in whole, no other substance being mixed with it.

The silo was continually open about three weeks whilst haymaking was going on. The grass was cut with the object of making hay, and if the weather permitted, hay was made. If the weather appeared likely to be unfavourable, the cut grass was taken to the silo. In any event, a few cartloads of grass were put into the silo daily. No covering, or weights, or pressure of any kind was used until the silo was finally covered. The fodder was eventually covered and compressed by means of 4-inch-thick planks, on the top of which pig-iron was placed at the rate of 130 lbs. to the superficial foot. I don't know anything about the weight of the grass put into or taken out of the silo. The iron weights cost me 47*s*. a ton delivered at Chapel-en-le-Frith. It is of the quality known as No. 3 Derbyshire pig-iron. I had 34 tons. I used the extra labour engaged for haymaking, and the men would have had to have been paid their wages, haymaking or not. Under these circumstances, I consider that I had little or no extra expense for manual labour.

The silo is emptied by cutting vertically, like hay in a stack. The cattle eat the pitted fodder most readily, in fact, preferring it to the hay in their racks. The food has been praised by all practical men that I have shown it to, and personally I am well satisfied. This year I purpose chopping the grass before putting it into the silo, as I think a greater weight can thus be obtained, and the silage when taken out will be handier for mixing with other foods.

I am 1200 feet above the sea-level. Haymaking in this district is always a month later than in most places, and we can very seldom commence to lead before 2 P.M., owing to the heavy dews and mists.

I have no drain from, or cesspool in the floor of the silo. I don't think either is necessary. The former might have a tendency to admit air into the pitted fodder, which must always be avoided.

I don't think it at all necessary or desirable to use salt, or to put a layer of bran, chaff, or any other similar substance on the top of the pitted fodder before covering it with the boards and weights. I used chopped hay for a covering last year, but intend not to use anything this. I have no waste from mould or any other cause.—*January 18th*, 1884.

10. *Mr. Arthur J. Scott, Rotherfield Park, Alton, Hants.*—I have been experimenting for eight years. My three silos may be described as follows: No. 1, 10 feet long, 13 feet wide, and 12 feet deep; it is an oval dug in the ground, which consists of a clay soil upon chalk; it is entirely below the level of the ground, and is lined inside with Portland cement. Nos. 2 and 3 are each about 11 feet long, 8 feet wide, and 8 feet deep; they are partly above and partly below the ground, and are made out of cattle-feeding pits, the sides being of brick. All are roofed. I have made several experiments with unroofed silos, but I do not recommend them for England, as there is too much rainfall in the winter here. No. 1 silo cost about 5*l*., and is

permanent. The conversion of the cattle-pits into silos Nos. 2 and 3 cost about 30*s*. each.

I commenced filling towards the end of June, and was about a month in completing the process. If the material sinks much now I shall put in a second cut of clover in September. I have successfully preserved vetches, clover, rye-grass, oats, and meadow-grass; and I have had numerous failures with other materials, such as mangold leaves, cabbages, comfrey, and artichoke stalks. I cut the crops to be ensilaged at the same time that I should cut them for hay, namely, when they are in flower. I have pitted them whole, and also chopped into inch lengths, but I do not find chopping to be necessary. The crop is best unmixed with either straw or salt; the former produces mould, as it is difficult to get the air out of dry straw. I think that it is impossible to fill a silo at one operation; but the quicker it can be done the better, as if done very slowly there is apt to be mould at intervals. My method is to trample the fodder down as the silo is being filled, and then to pile up the fodder on the top as high as I can. When this sinks to the level of the pit's mouth it is trampled down and filled as before, and this is continued until the pit is full, or all the available fodder used up. It is then covered with planks and weights. In No. 1 silo I compress the material with a wooden lever weighted at the end. Nos. 2 and 3 I have weighted with logs of wood, and shall also put mangold-wurzel on the planks. I have no doubt that the greater the pressure that can be applied the better; but the means of applying it must vary according to circumstances, and the materials available in the locality.

In No. 1 pit this year I have put 28 large cartloads of grass, of an estimated value of 10*l*., and the cost of labour and horses was 3*l*. 5*s*. 6*d*. In each of the pits Nos. 2 and 3 I have 24 loads of clover, the produce of 4 acres, and valued at 24*l*.; the cost of labour and horses in filling both was 6*l*. I hardly know how to value the covering and compressing, as rough beech planks and logs cut on the estate have been used; but their value is at any rate trifling. The cost of emptying a silo would be about the same as that of cutting hay from a rick. I have no doubt that the best way is to cut it down vertically like hay, as the pressure can then be kept on the fodder left in the silo.

I have found that the "silage" which I have been successful in preparing makes excellent food for cattle, especially for milch cows. It improves the colour of the butter, and most cows prefer it to any other food when it is well prepared. I find that horses and sheep will also eat it, but I have not fed them on it regularly. As to the effect of moisture, I would prefer that the crops should not be too succulent, as if they are they waste too much. I do not think that a little external moisture from rain on the crops before being pitted signifies much, but I prefer to pit them without rain wetting. If the crops are properly weighted, I do not see why the "silage" should not keep without deterioration several months while being consumed. If it is not tightly packed it must be consumed rapidly, or it will become mouldy. The keeping qualities are, in my opinion, all a matter of the exclusion of atmospheric air. If the fodder is heavily weighted, the air cannot enter; if the air gets into the fodder, it heats and becomes mouldy at once.

I have made no experiments worth recording in feeding pitted food to stock in conjunction with other feeding materials. I have fed cows with it and with a little hay for several weeks together, and found that they did well on it, and gave richer milk than on hay alone, or on hay with winter meadow pasture.—*August* 24*th*, 1883.

PS.—I have this season demonstrated, in feeding out of my silos, the great importance of cutting the silage vertically and not in horizontal slices. The

weights must be kept on the unconsumed portion, or the acetic fermentation and mould set in rapidly.

I would also warn beginners, unless they can give their constant personal attention to it, not to trust to levers, screws, and other mechanical contrivances to ensure pressure. Mechanical pressure requires to be continually attended to while the silage is shrinking, and every one must be prepared for indifference, if not for active hostility, from his employés for a certain time to a new process.—*February* 10*th*, 1884.

11. *Mr. C. F. Trepplin, Kenilworth.*—My fodder is stored in ten barns and barn-floors of different sizes, and also in a mere cart-shed, boarded off; and in five silos, of from 20 feet to 30 and 45 feet. Two of the silos are above and three below the level of the soil. The barns are mostly brick-built, some brick and wood. The doorways were boarded in. The silos were covered with litter, on which some galvanised roof-sheeting was put. The barns were not wanted for any other purpose, and of course were no expense. The silos were made at comparatively little expense, and will last more than a lifetime. The fodder was put in from July till October. It consists of grass, clover, rye and vetches, oats and vetches, and lucerne, put in when nearly ripe, and stored whole. In feeding, the silage is cut up with straw, but I did not use any salt or mixture of straw in pitting it. The barns and silos were filled at different times, according to convenience, one after the other, and then refilled when the fodder had sunk down. This work was mostly done when nothing else could be done on the farms.

The first barns and silos were weighted with old timber after the fodder had been trodden down by horses; afterwards very little trouble was taken in filling up the silos and barns, and merely some old litter, and sometimes sand, was put on the top of the fodder. I took no record of the weight of the crops put in, but I pitted all the fodder, and made no hay. I do not consider that there was any more expense incurred than in making hay—rather less, because hay could not have been made during the rainy weather, while the fodder was pitted or stacked.

Emptying the barns and silos is more convenient and less costly than cutting hay. It is cut down vertically. It should also be observed that it does not require insurance against fire.

I have come to the conclusion that anybody who has a barn or shed, or can make a hole in the ground, will be independent of the weather to preserve his fodder, and maintain on it more live-stock than on hay. With regard to the best condition to pit the crops, I think that those containing not much succulence, and pitted in dry weather, ought to be watered when pitted in barns or sheds, especially before a second layer is put in, or when the silos or barns are filled a second or third time. The fodder preserved by me can be consumed by degrees without deterioration. A trifle of mould on the outside is of no consequence, and if the fodder be shaken and cut up with straw, it is readily eaten by horses and cattle. I have no experience that pitted fodder does not keep sound for a few days. When pitted in barns, there is more fermentation, and the fodder is sweeter and warmer than when preserved in underground silos. This fodder is much more suitable as food for stock than hay, especially when the latter is made in bad weather. I feed over a thousand animals with it, and find them in better health and condition than they were in former years, when fed with hay.—*January* 29*th*, 1884.

As this is probably the most extensive development of the system of ensilage that at present exists in the United Kingdom,

a few additional remarks from me may not be considered superfluous. I received from Mr. Trepplin a number of samples of silage from his different barns and silos, and found them possessed of that peculiar aroma of aldehyd, like Cavendish or honeydew tobacco, which is frequently observed in silage, although it may have arrived at the stage of acetic fermentation. They all went mouldy after a short exposure to the air, as generally happens when the silage is very moist, as was the case in these instances. Being somewhat impressed with the scale on which Mr. Trepplin was using the system, and with the general success which had attended his efforts, Dr. Voelcker and I visited him on February 16th. Partly as landlord and partly as tenant, Mr. Trepplin farms about 3300 acres; and as he now makes no hay, Rumour may not exaggerate in her usual way when she credits him with having made 3000 tons of silage last year (1883). I was therefore anxious to learn his views on the question of Silage *versus* Hay. They may be thus stated in general terms:—Although there is more carting in making silage, the extra cost is more than balanced by the "not making" of the hay. Mr. Trepplin also asserts that he has found the same quantity of grass of the same quality at least twice as valuable for feeding purposes if made into silage as if made into hay. Inferior and overripe grass or aftermath may prove, in his opinion, actually less valuable *per ton* than if it had been made into silage. He remarks also that horses and cattle will always eat silage made at any time and in any weather, but they will not always eat bad hay; and, if fed on bad hay, they often contract diseases of which silage is quite innocent. Some farmers may say that these are the opinions of an enthusiast, but at any rate they are based on the results of feeding more than a thousand animals.

12. *Mr. N. Eckersley, M.P., Standish Hall, Wigan.*—In the summer of 1883, two silos were erected inside the old barn at Standish Hall, each 18 feet long, 10 feet wide, and 9 feet deep. The inside of the walls and the surface of the bottoms were plastered with a coating of Portland cement, left smooth, and the corners were rounded off. The bottoms had a slight inclination from the sides to a channel in the centre. The channel also inclined slightly from the back to the front wall, where a small cesspool was formed, 12 inches by 3 inches, and from this a lead pipe one inch in diameter was inserted, to convey the liquid which exuded from the silage through the front wall into a small well. At the commencement this lead pipe was plugged up. Ten acres, statute measure, of second-crop clover and rye-grass yielded 80 tons in 80 cartloads of one ton each. Cutting commenced on the 15th of September, and continued at intervals until the 29th of September. The silos were filled alternately. One ton of old dry clover-hay was spread at the bottom of each silo, in the expectation that it would absorb all the liquid which drained from the silage.

No. 1 silo was filled and pressed down as follows:—

Sept. 15th.—14 loads of clover and rye-grass filled it to the top, and it was then left to subside.

„	18th.—10	do.	do.	do.
„	22nd.— 4	do.	do.	do.
„	26th.— 6	do.	do.	do.
„	28th.— 4	do.	do.	do.
„	29th.— 2	do.	do.	do.
	40 loads.			

Between the dates No. 2 silo was filled with 40 loads in the same manner. The clover and rye-grass was carted to the silos immediately after it had been cut. The cost in wages of cutting, carting, raking, filling, covering, and weighting was 4*s.* 9½*d.* per load. The whole of the clover and rye-grass was cut and put into the silos when the weather was fine, except one day, when it was showery.

On September 29th, a layer of dry straw, about three inches in thickness, was spread on the top of the clover in each silo. The straw was then covered with boards, and about 15 tons of stone were placed on the top of each silo. During the intervals of filling, each silo, when left to subside, was covered with boards and weighted with about 5 tons of stone. The silage gradually subsided, and at the expiration of 14 days it had sunk in each pit from 9 feet in depth to an average depth of 6 feet 9 inches. At this time it was evident that the old hay at the bottom of each silo was not absorbing all the liquid which drained from the silage, and then the plugs in the lead pipes were withdrawn and about 40 gallons of liquid extracted from each silo. The liquid has been drawn off daily since then, but the quantity gradually lessened, and at the date of this memorandum very little drains off. There has been no further subsidence in either of the silos since the 13th of October.

On the 29th of October No. 1 silo was opened, and the quality found to be good. Forty-two head of cattle (milch cows, in-calf heifers, feeding stock, and stirks) are consuming it, and all doing well. It is estimated that each silo will contain 30 tons of silage fit for use, besides the liquid.

The following analyses were prepared by Mr. Ralph Betley, the public analyst to the borough of Wigan. The samples of clover-hay and silage which were analysed were both grown on the same field this year, the hay being the first crop, cut at the end of June, and the silage the second crop, cut in September.

	Dried at 212° F. Hay.	Silage.
*Albuminoid substances soluble in water ..	2·87	7·55
† Ditto ditto insoluble in ditto ..	7·83	4·89
Sugar, gum, and extractive matters	47·31	53·44
Fatty matters, chlorophyl, &c	2·96	3·11
Indigestible woody fibre	32·84	22·16
Mineral matter soluble	2·51	5·71
Ditto insoluble	3·68	3·14
	100·00	100·00
*Containing nitrogen	0·46	1·21
† Ditto	1·25	0·75

Report.

"The hay had all the characteristics of good clover and rye-grass hay; the silage was much darker in colour than the hay, and was very odoriferous, having a faintly acid smell, accompanied by a very persistent smell of essen-

tial oils. This smell was entirely absent from the hay, and this difference will form one reason why the silage is so liked by the cattle. The analyses show, however, that besides this a change is produced in the silo, due in great measure, no doubt, to the partial fermentation, which is set up there, and which beneficially affects the food-value of the product as compared with hay. This change results in,—

"1. An increase in the amount of soluble albuminoid substances, or flesh-forming compounds.

"2. A decrease in the amount of indigestible woody fibre, which of course means an increase in the total amount of digestible matter as compared with hay.

"The liquid which drained from the silage was glutinous, slightly acid, and possessed a smell of essential oils, like the silage did. It may be mixed with food or drink for cattle or calves.

(Signed) "RALPH BETLEY."

It is evident from the results already ascertained that the produce of an acre of clover and rye-grass converted into silage will considerably exceed in value that which the same produce would if converted into hay. The system deserves the attention of the agriculturists of the United Kingdom.—*November* 26*th*, 1883.

13. *Mr. William Wood, Clifton, York.*—Each silo is 11 feet deep, 10 feet wide, and 15 feet long; they are both entirely below the level of the soil, and are built of concrete, and have a roof. The two cost 100*l.*, and I hope they will last a lifetime. They were filled in in July and October with grass and second crop of clover. I should think that when the crops are ripe would be the best time to pit them. They were put in whole, with a little salt, but I shall not do so next time. Each silo is filled at one time.

The material is covered with boards and bricks, and when put in weighed about 40 tons. I should say it has not lost much. The labour alone cost 34*s.* an acre. It was a mile and a quarter to carry. The cost of emptying the silo is about 2*s.* a ton; we cut it vertically. By this process I obtain good fodder, and cheaper than buying turnips. With regard to the influence of moisture, I say put the crops in during dry weather; and the faster the fodder is used the better, the air being the great enemy. As to my experience, I can only say that we give our stock along with it both hay, cake, and bean-meal; but I don't want to teach yet.—*February* 6*th*, 1884.

These silos are very practically and substantially made, and the roof being 12 feet above the upper margin of the silos, the intermediate space can be used for storing hay, straw, &c. This roof contributed to the total cost of the silos as stated by Mr. Wood. I visited the silo on January 25th, and saw a complete face of the pitted fodder in one of the silos. Its quality was very good. The other silo had been emptied. Like some other suburban dairy-farmers, Mr. Wood is hopeful that the system of ensilage will relieve him from the necessity of buying roots for winter use at prices beyond their feeding value.

13A. *Mr. George Broderick, Hawes, Yorkshire.*—I have two silos, each 14 feet square by 18 feet deep; one 22 feet 6 inches long, 10 feet wide and

19 feet deep, and one 13 feet square by 15 feet deep. Some of them are above the level of the ground, and some partly above and partly below. They are all concreted stone hay-barns, constructed of stone and mortar walls, and plastered with Portland cement, mixed with sand in the proportions of about two of sand to one of cement, and finally whitewashed over with cement. The floors are of concrete, coated in the same way with cement. They have permanent slate roofs. I have not tried any without a permanent roof.

The first two cost about 50*l.* to convert, the second about 20*l.*, the third about 10*l.* I expect them to last as long as any ordinary farm-buildings. They were filled in the latter part of July and the beginning of August with permanent meadow grass, cut just before it became ripe, or when it was in the best condition for making good hay. It is pitted unchopped, as it seems to be quite unnecessary to chop the finer grasses. I do not mix any other material with the grass, and do not think salt would tend to improve the preservation. Straw, I think, unless mixed with a very wet or succulent crop, would tend to increase the heating, or perhaps cause mould. The silos are filled generally at intervals, sometimes two or three days in succession; but without weighting each night, allowing the grass put in each day to press that previously put in. For instance, I fill the silo perhaps half full one day, leaving it all night, and the next day fill it about full. It will perhaps sink a little by next morning, when I would fill it up again and put the weights on. After it has stood a week or two it will have sunk about halfway down, when it can be again filled up. I do not know that there is any other advantage in this except economising space. I have filled silos to the top in one day and weighted them, and the preservation seems to be quite as good as when filled at intervals. When filled at long intervals there are dark divisional lines between each filling. The fodder is weighted with loose stones laid on a covering of 1-inch boards in three of my silos; in one I have used a mechanical arrangement which has answered fairly well. I am not able to tell the exact amount of pressure I applied. It was continued until the silage was pressed as solid as it would go. I prefer the mechanical pressure, on account of the quickness of application and the smaller amount of labour it requires in comparison with dead-weights. I had no facilities for weighing the large amount of grass that I pitted last year.

The expense of filling the silo varies according to circumstances, from about 6*s.* to perhaps 15*s.* or 1*l.* per acre, or 1*s.* to 2*s.* 6*d.* per ton; but I have not kept an accurate account, as we were generally making hay at the same time that we were pitting grass. The cost of emptying is a little more expensive than feeding hay, though not much, on account of the greater weight; and it will vary according to the manner of feeding and the distance it is to carry. I cut it down vertically like a hay-stack, so far, but am going to try taking it off the top in the next silo I open.

The advantages of ensilage are a complete independence of the weather in harvesting the fodder crops; an always certain and reliable food, more nutritious than hay, and capable of feeding about 30 per cent. more stock than the same grass would if made into hay, and on the whole a saving in labour. The more succulent or wet the crop, the less will be the heating during fermentation; there is more exudation of juice, and the resulting silage is perhaps a little darker in colour than that made from a drier material. Silage made from a dry crop, I believe, smells rather more like hay.

The use of the contents of a silo may be extended over a whole winter without deterioration to the silage, provided no surface is left exposed to the air for long, and the weight be kept on that part not being used. I have not seen an instance where pitted fodder would not keep a few days; but if such cases occur, I should think it is owing to mismanagement of some kind. Perhaps the weights are taken off the whole bulk of the fodder at once, in

which case the top part would spring up and admit the air, when fermentation would at once set in, and heating take place, followed by moulding. I have tried feeding cattle on silage alone, and find they thrive quite as well or better on it than on the best of hay. The milk and butter yield especially is much superior to that from hay; and from experiments I have made, I have come to the conclusion that a given quantity of grass is worth about 30 per cent. more when made into silage than if made into hay.—*March 10th*, 1884.

I have only to add to the above account that I visited Mr. Broderick on January 24th, and found his silage of good quality and well preserved, but rather sour. The stones used as the weighting material were calculated to exert a pressure of $1\frac{1}{2}$ cwt. per square foot.

B. Silage Partly Chopped.

14. *Mr. John Bateman, Brightlingsea, Colchester.*—The total length of the silo, which is in three compartments, is 47 feet outside measurement, and 45 feet inside, with an inside width of 15 feet, and outside of 17 feet. The inside depth varies gradually from 12 feet to a maximum of $13\frac{1}{2}$ feet, and the silo is a little more than half sunk, so that it stands about 5 feet 6 inches above the roadway. The outside walls are 1 foot thick, viz. 11 inches of concrete with 1 inch of cement laid on so as to give a perfectly smooth interior face. The floor is 10 inches in thickness, and consists of brickbats filled in with concrete and faced with cement. The two partitions are each 8 inches thick. The roof of two of the compartments consists of curved corrugated iron running on a railway; but this form of roof can also, if desired, be extended to the third compartment. At present, however, I am trying the effect of roofing and weighting the third silo by building a haystack upon it. The total cost was about 160*l*., but if the roof had been made of Willesden paper it would have been 20*l*. less. The cost would also have been lessened by 12*l*. if, instead of being placed on a perfect flat, the site had been a hillside. The silo will practically last two lifetimes.

Silo No. 3 was filled on June 18th, 19th, and 21st to a depth of 8 feet with chopped red clover, then $2\frac{1}{2}$ feet of unchopped, and finally $1\frac{1}{2}$ feet of green grass. Silo No. 2 was filled on July 25th and 26th with 12 feet of unchopped green grass. Silo No. 1 was completely filled with $13\frac{1}{2}$ feet of chopped green maize in the beginning of September. The clover and meadow grass are preferred to be used when they are fit to cut for hay, and the maize on the withering of the male blossom, and before the female has shot the silk a week. It depends upon circumstances whether the crops are pitted in a whole or a chopped state; but I vastly prefer to chop everything with a powerful chaff-cutter—the clover and grass to one-third of an inch, while the maize is better for being even smaller. Two bushels of salt have been mixed with the grass in No. 2 silo, but I have never tried straw. The mode of filling has been already stated, but I may add that I have never succeeded in filling more than 9 feet in one day; this, when weighted for the night, settles into about 7 feet. I then fill up the rest (after shifting the weights), and this in its turn settles and requires a third filling. I have no doubt, however, that were I to treble the man, boy, and horse-power used in treading, I might so compress the stuff as to completely fill one silo in a day. On silo No. 3, I used 4 men, 6 boys (volunteers) and a cob to stamp it tight. I can see no particular object in hurrying on the filling with so large an addition to the labour bill. Compression is done as follows: Each silo being a perfect square of 15 feet, I have 15 planks, just a trifle

under 1 foot broad, cut to 14 feet 11 inches, so as to leave a small windage for the escape of putrescent gases. On these boards I place my weights.

The theory I go upon is this: that the pitted stuff will develop two gases, namely, (1) heavy (carbonic acid)—let this remain in the body of the fodder; and (2) putrescent gases—let them escape upwards as soon as they please, "good riddance of bad rubbish." I consider the so-called "hermetically sealing of a silo" upwards a "damnable heresy." Lord Tollemache, with whom I have had a long talk over the matter, is going to seal up his silos as well as he can with *bran*. Now bran will do all the harm it *can*, but happily, being *bran*, will let much of the light putrescent gases escape, and their place will be taken by the preservative heavy gas.

The weights on silo No. 3 consist of 1500 bricks laid on the planking; over these a small haystack is built to try experimentally whether it will serve the double purpose of weight and roofing (it has answered the purpose most admirably). On the two other silos I use old American import oyster-barrels (costing 7*d.* each), filled with gravel and headed up with concrete. These weigh $3\frac{1}{4}$ cwts. each. I have not used any mechanical contrivance for weighting, but Mr. Diss (a builder and contractor), of West Bergholt, Colchester, has suggested to me a most feasible plan of mechanical weighting, which I intend to try in 1884. As also what seems a still better method, patented by Messrs. Reynolds of Blackfriars Road (see p. 205), which he shows at work, sinking rubbish in a small silo with a hydraulic jack.

The crops were not weighed as they were put into the silos; but No. 3 took about 32 two-horse waggon-loads of green clover, grass, &c., to fill it. The cost of filling and compressing is about as follows:—

	£	*s.*	*d.*
1 man and 1 boy with engine .. .. (say)	0	6	0
2 men feeding the chaff-cutter	0	5	0
4 men and 6 boys stamping inside	0	16	0
Cob's time (one-third of a day), used only when 6 feet of stuff had been put in	0	1	6
	£1	8	6

Add oil, coal, and water for steam-engine.

As none of my silos are in practice filled in one day, but in, say, 18 or 19 working hours, the cost of filling each silo, counting only labour, and irrespective of the wages of men cutting the crops, and of teamsters hauling it, would be about 2*l.* 5*s.* I should add that the covering and weighting can be done by 3 men in about 2 hours. I do not look upon filling and emptying the silo as a question of cost, because the man or men who tend your stackyard, cut hay, slice turnips, grind cake, &c., will now simply, after assisting to fill the silo, drop the hay-cutting, and cut into the silo with a hay-knife or an extra sharp spade. It is much simpler to cut vertically when you weight your silo with planks, and afterwards bricks, barrels, &c. I have come to the conclusion that every silo should have a doorway at a low level—no regular door—but a substantial imitation of one, without handle or hinges, to let into the doorway loosely. This is kept in place by four "cupboard-buttons," and plastered even with the wall of the silo with some inches of wet clay. When you wish to open, you have simply to pick away the clay, unship your pseudo-door, and work into your mass of silage; soon you are able to get a clean cut from top to bottom.

Not having pitted green fodder before this season (1883), I can only say at present, with regard to results, that the cattle eat it greedily, and that my silage-fed ewes, some of which suffered severely in October from foot-and-mouth disease, have since given a remarkable strong crop of lambs, with less trouble than usual to the shepherd, by reason of the mothers' full bags.

As to the influence of moisture, I have found that crops pitted very wet rise to a temperature of about 130° F. when pitted green, but when cut on dry mornings they will not reach more than 110° F. As far as my experiment has gone, I should say pit the crops wet or wettish. If heavy pressure is put on, no vertical cut can admit much air into the stuff, which will readily keep good for days and weeks, perhaps more, without turning mouldy. My minimum weight is 120 lbs. to the square foot. If, on the contrary, you weight your silo lightly, say, 40 lbs. to the foot, or less, you will obtain a product which air can easily enter—and spoil. Cattle and sheep long for "silage" at the first smell; bullocks, for instance, will horn one another away from a lump of it, even when plenty of other food, such as turnips, beet, or cake, is in the yard. Many horses, on the contrary, regard it with suspicion, and nature evidently does not intend ensilaged grass for them as a substitute for hay. I shall, however, certainly experiment with it upon brood mares.—*November* 1883.

PS.—Since writing the above, the silos have been opened in exactly the reverse order to the filling. Results:—

Silo 1. (Maize of September 1883.) Excellent fodder, slightly too acid for choice, but relished by stock.

Silo 2. (Coarse grass, July 1883.) Good useful fodder, none the better for the added salt.

Silo 3. (Clover, June 1883.) Very strong smelling stuff, but sweet and alcoholic, much relished by stock, producing an increased yield of milk and butter from the cows to which it is fed, even in a more remarkable way than the two former sorts of silage.

As a further result of the experiment, I may add that I mean to grow a much larger breadth of maize in 1884, and thoroughly to test it as fodder. In this neighbourhood it is possible to grow a crop of rye in front of it, then to break up your land, dung it, and drill in your maize the first week in June, which date is quite early enough.

On September 6th, 1883, I inspected Mr. Bateman's silos at "The Lodge Farm," Brightlingsea. The details given above leave little more to be added, except that it may be useful to draw attention to the fact that the green maize, with which I saw No. 3 silo filled, is a unique example within my English experience of the growth of that crop on a large scale for pitting purposes. The crop was good, notwithstanding that a large proportion of the seed first sown did not germinate, and that a second sowing therefore became necessary. Naturally, the plants produced by the latter were stunted, and so the weight of fodder per acre was very much less than it would have been if all the first-sown grains had germinated. The average length of the stalks of the plants which had been produced by the earlier-sown grains I estimated at 7 feet, and their average diameter about $1\frac{1}{2}$ inch. This is by no means a bad result for maize sown in England. A Bentall's chaff-cutter was fixed on a raised platform at the side of the silo which was being filled, and it chopped the materials into lengths of about three-eighths of an inch. The chopped maize fell from the chaff-cutter direct into one corner of the silo, which naturally

caused a maximum of labour in distributing it evenly over the whole area. At my suggestion some boards were fastened together and placed slantwise, so as to receive the chopped material and conduct it by its own weight more towards the centre of the silo, and thus ease the labour of distribution. About seven lads were employed in spreading, treading, and ramming the cut maize, two men were at the chaff-cutter, two were kept at work unloading the carts, and one man attended to the engine. These were in addition to the men employed cutting the maize in the field. The details as regards the filling of the other silos are given by Mr. Bateman himself in the foregoing statement, and it only remains to add that the silos have been constructed by him for the use of his tenants, but that this year all the crops pitted, viz. grass, clover, and maize, belong to one of them.

15. *Lord Middleton, Applecross, Ross-shire.*—The silo is divided into two pits by a concrete wall; each pit is 8 feet deep, 7½ feet long, and 6½ feet broad. It is below the level of the soil, having been dug under the floor of a hay-barn. The bottom of the pit is laid with concrete 3 inches thick, the sides and ends 8 inches thick; the bottom and face of the walls are plastered all over with fine sand and cement: I have no experience of a silo without a roof. The cost was 12*l.* 14*s.* The pit is substantially made, and will last for years.

It was filled on the 20th of September, 1883, with green corn and partially ripe corn, which had been laid, and with green natural grass. Most of the material was green and wet, but a small quantity was partly ripe and dry. The corn was chopped to 1-inch lengths, but the grass was not chopped. Nothing was used to mix with it.

The silo was first filled up at one operation, and after ten days was refilled, because I considered that the sooner it was filled the better. The material was carefully and well tramped, then thick tarpaulin was placed over the silage, care being taken to fit it close to the sides; over that, boards closely jointed, and fitting the pits exactly, were used. Pressure was obtained by sand-bags to the weight of 3 tons for each pit, when finished. The fodder was not weighed. The total cost of filling and covering was 3*l.* 5*s.*, subdivided as follows:—Mowing, 12*s.*; carting, 12*s.*; chopping, £1 4*s.*; pitting, 4*s.*; treading, 9*s.*; and weighting 4*s.* The boards cost 16*s.*, but this item is included in the original cost of the silo.

I purpose to give the silage to the dairy-cows in April and May as a substitute for turnips.—*January* 16*th*, 1884.

Samples of both kinds of silage were received on December 24, 1883, and were both of good quality. The unchopped meadow-grass, which contained 74·4 per cent. of water, was, however, rather better than the chopped green corn, which contained 74·8 per cent. of water.

16. *Mr. A. W. F. Eade, Brafferton, Darlington.*—My silo is 12 feet long, 6 feet in breadth, and 9 feet high, above the level of the ground. It is built of 18-inch walls, made up of 13 inches limestone, 4½ inches brick, and ½ inch cement, with a cement floor, and a movable corrugated iron roof. It has a 2-inch wooden door, 4 feet by 2 feet 6 inches, conveniently placed 2 feet 6 inches

from the floor, for emptying. Its first cost was about 15*l*., and I expect it will last for years. It was half filled with tares in July, and filled up with clover and rye in September, the former being chopped to $1\frac{1}{4}$-inch lengths, and the latter put in unchopped. The tares were put in just before podding, and the clover and rye when ripe. Salt, at the rate of $\frac{1}{2}$ lb. to 1 cwt., was added; but I deem it unnecessary.

Mode of procedure in filling would be to fill as much as possible in a day (fine), and weight immediately afterwards. Rain-water cannot improve silage. The fodder was compressed with scoriæ bricks $9'' \times 5'' \times 5''$, the weight of each being 18 lbs. They cost 10*s*. per ton. They fit 9-inch planks (2 inches thick), which lay on the silage with nothing between. The total amount of pressure I consider to have been as follows:—

Tares 100 lbs. per square foot.

Clover and rye 130 lbs. per square foot.

The weights of the crops put into the silo were 6 tons of tares, and 5 tons of clover and rye. The expense in labour of filling the silo, &c., was 10*s*. per ton chopped (tares), 5*s*. per ton unchopped (clover and rye). A man and boy can remove the weights in one hour, and it will take the same time to put them on. The weights rest on the side-walls when not used.

The silo is emptied by means of the side-door before mentioned, and the material is cut vertically like a stack in 9-inch breadths to suit the boards. The "silo" is conveniently built in a corner of the building. By ensilage I find that I obtain a succulent food during the winter. The *tares* are unsatisfactory; they are not rotten, but have a disagreeable smell; beasts will not eat them. The *second cut of clover and rye* (put in on top of the tares) is first-rate, with a pleasant smell; stock eat it greedily, and do well with a small proportion of dry food. If tares can be successfully siloed, they would greatly enhance the value of strong-clay farms, such as we have in this district. They would take the place of turnips or bare fallow in rotation, and 6 or 8 tons per acre might be grown, and we cannot grow much more than this in turnips. The land could also be cleaned after the removal of the tares.

With regard to the keeping qualities of the fodder, I should say that the silo has now been opened ten weeks, and is as good as when first cut into. The silo is not drained, and no liquid is at the bottom of it, although the tares are rather moister at the bottom than at the top. Clover and rye does not show much difference. My experience with tares is disappointing, as I had great hopes of this material on account of the bulk we can grow per acre, and also their feeding properties in a green state. I could not wish for anything sweeter than the clover and rye, and have no doubt at all as to its wholesomeness as food for stock. My experience is with young stock, from calves to twelve months old. It is possible the tares were cut too early. Tares have naturally a strong taste, and a more palatable food might be obtained by allowing the juices to become more absorbed in the plant.

17. *Mr. W. Stobart, Pepper Arden, Northallerton.*—I have two silos, one being 27 feet 6 inches long, by 11 feet 6 inches wide, and 12 feet 6 inches deep; the other 18 feet long, by 8 feet 3 inches wide, and 10 feet deep. The bottom of the largest silo is 3 feet below the surface of the ground, and that of the smaller one is only 1 foot below. The silos are really converted buildings, which are peculiarly well adapted to the purpose, both from situation and structure. They are covered with a permanent roof, and although I have had no experience with uncovered silos, I should not recommend them. The silos were filled from time to time, commencing on June 30th. At present (August 10th) they are full to within 2 feet of the top, and I fill as the material subsides. Directly after each filling, the weights are at once applied. It is not possible to fill either of my silos at onc

operation, and the principle of ensilage being founded on the exclusion of atmospheric air, I think this end is better gained by periodical fillings, and immediate application of pressure after each filling. The materials hitherto used have been wood-edges, grass from rough lawns, coarse as well as good meadow-grass, clover and rye-grass, green oats, tares, &c. As far as possible I am keeping each description separate, so as to see how they come out. The materials are pitted when at their fullest growth, and both chopped and long; but I prefer to chop it, because in that state it packs better, sooner, and closer; and when taken out is at once available for mixture with other foods. Chopping is done by an ordinary 10-inch chaff-cutter, which cuts half-inch lengths. If I were getting one for the sole purpose, I believe that 2-inch lengths would be equally good. I mix about ½-lb. of salt to the cwt., not that I think it is necessary for its preservation, but in any event it is good for the cattle. I should on no account use any dry material during filling, but when the silos are finally filled up I shall probably put a layer of dry bran on the top.

The material is compressed by means of iron blocks made for the purpose, and weighing 1 cwt. each. Three men can lift 24 tons from the bottom on to the side in 3 hours, and can replace them in little more than an hour. The pressure amounts to about 1½ cwt. per superficial foot. As to the weight of the crops put into the silos and that of the preserved material taken out, I am carefully trying to ascertain this in the case of one silo, but there should not be any appreciable difference. The cost of filling and the expense of covering, compressing, and emptying the silo is being carefully kept, and will be supplied when completed. The blocks cost at present about 45*s.* per ton, delivered at the nearest railway station. The iron, being No. 3 Foundry, is a little more costly than an inferior quality of iron, say, one shilling per ton; but their value for sale at any time is nearly equal to their first cost, and therefore only the interest on the capital invested should be charged annually.

I propose to cut out the material exactly as from a stack.—*August* 10*th*, 1883.

PS.—Assuming the amount of material dealt with during a fair day's work is 20 tons, as cut from the field, and that the distance to be led does not exceed a quarter of a mile; further, that this material would be mown off 3 acres of land by a man with a two-horse mowing-machine in 3 hours, the cost would be as follows:—

	£	*s.*	*d.*
Mowing	0	6	0
Carting to silo (3 horses)	0	15	0
Treading 3 men; Forking on to carts, 2 „; „ from carts, 1 man; Feeding chopper, 1 „ } at 3*s.* per day ..	1	1	0
Raking, 3 boys or women	0	3	0
Allowances .. .. (say)	0	5	0
Putting on and taking off weights	0	4	6
Total	£2	14	6

This comes to about 2*s.* 9*d.* per ton, or, at 7 tons per acre, to 19*s.* 3*d.* per acre. I should consider this ample, but I may add that a farmer who has always a certain staff of men and horses to keep would not be put to quite so much expense. It will be observed that the cost of chopping is not included, because the power is obtained from a sawmill, and is so small that its loss is not felt.*

* If we allow 5*s.* per acre for this (irrespective of the cost of the man feeding, as given above), it would then bring the total up to Mr. Easdale's estimate of 24*s.*, as mentioned below.

My first visit to Mr. Stobart's was made on August 21st, 1883. Each silo has a tap at the bottom, and from time to time juice is drawn off and used for feeding the pigs, who take it greedily. This squeezing out of the juice of the fodder seems to indicate that the silage has been too heavily weighted, at any rate for such material as was pitted in a chopped state. Great care had evidently been taken in filling the silo, but necessarily at some expense, namely, not only that incidental to chopping by steam-power, but that entailed by the method of spreading and treading adopted—three men employed to catch the cut grass in baskets, spread it evenly over the floor, and tread it down. The examination of a specimen of silage taken at this visit showed that it contained 76 per cent. of moisture. Kept in a wide-mouthed stoppered bottle, a portion of it has remained good ever since. Dr. Voelcker's analysis of the drainage material yielded the following results :—

Water	93·11
Organic matter	4·36
Mineral matter	2·53
	100·00

The two latter items, which together comprise the dry residue, contained :—

Albuminoids*	20·91
Acids	10·71
Extractive matters	31·72
Ash	36·66
Total	100·00

* Containing nitrogen .. .. 3·34

At my second visit, on January 21st, 1884, the results of the process adopted were clearly seen. The silage was generally in a good state of preservation, but some of the layers were much better than others. The least attractive portions were those which contained more or less prickly comfrey. On the whole, I inferred that a smaller weighting would have produced a result quite as good to the eye, and doubtless better to the more searching enquiry of a chemical analyst. It must be stated, however, that the expressed juices mentioned above are by no means wasted, as the liquid is mixed with the pigs' food, and is stated to be much relished by those omnivorous animals. A great portion of the material in Mr. Stobart's silos consists of rough grass from under trees, roadside cuttings, and odds and

ends of every description from nooks and corners in the park—in fact, every description of green food that might otherwise have been wasted had been put into the silo.

Some additional facts ascertained during this visit may be worth recording. First of all, I should mention that the covering is done with great care, as follows:—Immediately upon the chopped fodder a layer of bran about 2 inches thick is placed, then the boards, along the joints of which thin strips of zinc are placed. Mr. Easdale (agent to Mr. Stobart) asserts that these precautions prevent the development of any mould whatever, and keeps the bran as dry as dust. The cost of the zinc is stated to be very trifling—not more than 1*l.* for the larger silo described above, which contained about 90 tons of silage. Mr. Easdale put the cost of making hay in fair weather, supposing the crop to be 1½ cwt. per acre, at 20*s.* per acre; and the cost of preserving the grass from the same land by ensilage, including cutting, carting, chopping, &c., at 24*s.* per acre, notwithstanding that he reckoned 1 ton of hay to be the dried result of 5 tons of grass. The great expense of the process of ensilage is, no doubt, the carriage of so large a quantity of moisture, and if the field is at any great distance from the silo this must be an important consideration. Mr. Easdale also stated that the beasts received 75 lbs. of silage per head per diem, and that he regarded this as equal to 95 lbs. of turnips and 25 lbs. of hay. In fact, he positively asserted that in his opinion the silage was worth 2*l.* per ton, which, at the rate of 5 tons to 1 ton of hay, would require hay to have a feeding-value of 10*l.* per ton to be equal to the silage from the same quantity and quality of grass.

18. *Mr. J. Swan, Stonefield, Lincoln.*—I have two silos, each 27 feet long and 14 feet deep, and entirely below the level of the soil. They are constructed of 14-inch brick walls grouted with hydraulic lime-mortar and faced with Portland cement, with which the bottom of the pit was lined to the thickness of 3 inches. This was considered sufficient, as the pits were excavated out of solid rock. The silos are covered with 3-inch planks, which form also the floor of the barn or store-house which has been built over them. The first cost of the silos without the store-house was 100*l.* 8*s.* 3*d.*, and I expect that they are permanent.

Filling the silo No. 1 was commenced on June 20th with long grass; and by means of temporary sides above the walls the material was piled up to a height of 2 feet 6 inches on the 22nd, and was then weighted to the extent of 120 lbs. to the square foot. On July 10th it was filled up again and the weights replaced; and finally, on August 7th, the space created by further shrinkage was filled up with green oats, tares, and lucerne chaffed to the length of 1½ inches, and weighted as before. The filling of silo No. 2 was begun on July 5th and finished on the 7th, also with unchaffed grass. It was then partially weighted with 40 lbs. per square foot; and on the 9th the

weights were taken off, the silo refilled, and the material weighted down with 120 lbs. per square foot. In both cases the material was first covered with inch boards, about 1 inch shorter in length than the width of the pits, and bricks were then used to the weights stated. No salt or other material was mixed with the green stuff, and some details of the procedure, such as not chopping the green oats, &c., in shorter lengths, and not chopping the grass at all, were adopted, owing to the smallness of the occupation and the irregularity of the growth of the crops not making it worth while to hire a steam-engine.

The weight of the materials put into the silos was 96 tons, but I cannot undertake to keep an account of the weight of material taken out, as the cowman takes out rations for the cows morning and evening, and will do so for the next eight months. The total expense connected with the filling of my silos came to 5*s.* 6*d.* per ton for everything; but I had to pay highly for labour, as I live in the suburbs of a town where labour is very dear. The process of emptying the silo is done by cutting the material down vertically, as hay from a haystack.

I have no arable land, and by the process of ensilage I hope to save the purchase of roots, grains, &c., for winter use, and the securing of much better milk, cream, and butter, and in larger quantities than I have had when using roots. My experience in the use of pitted fodder for stock extends over a period of three weeks only, during which my milch cows have been fed with it night and morning, on coming in from and before going out to grass. The cows eat it with avidity, and the milk has slightly increased in quantity and greatly in quality. I give them a quarter of a linseed-cake and a quarter of a cotton-cake each per day. In my opinion the ensilage system is of the greatest possible importance to farmers generally, as it makes the dairy-farmer without arable land independent of root crops, and the arable farmer may turn dairyman without grass-land. This appears to me to be of paramount importance to the latter class, as with a little management and with the help of a silo a very heavy weight of green food may be grown and stored without in any way trenching upon the present system of arable farming. By this means much more stock can be bred, and a much larger quantity of cheese and butter be produced, than under the present system, thus enabling the British farmer to put into his pocket at all events a share of the enormous sum now paid annually to foreigners for those products. I think this may be done by sowing rye or any other early green crop suitable upon the wheat stubbles. By so doing, the exposure without a crop of the bare fallows, so much deprecated by agricultural chemists, would be avoided. The green crop would be cut and pitted in the third week in May, leaving ample time for cleaning the land for the turnip crop. This plan is now adopted by farmers when growing tares for consumption by cart-horses on their own farms.—*October 14th*, 1883.

PS.—My cows, calves, and pigs have been feeding on the silage (without hay or roots) since September. They are all in first-rate condition, and the yield of milk and butter has been most satisfactory. Having read in the papers that butter from silage-fed cows is tainted with the flavour of silage, I may say that such is not the case; but if through want of care the milk during milking time or afterwards should be left under the influence of the smell, it will, as a matter of course, become impregnated with that as it would with any other pungent odour. Since I have given strict orders on this point, there has never been the slightest flavour in milk or butter. I am perfectly convinced that with underground silos a pump will be necessary, and the condition of the silage will not be endangered by the use of it.—*February 7th*, 1884.

I visited Mr. Swan on October 29th, 1883, but found very little to add to the description given above. The silage, like that from some other silos in which *long* grass had been preserved, had become almost putrid; but as the cows ate it readily, throve well upon it, and yielded an abundance of good milk and butter, Mr. Swan was tolerably satisfied with his first attempt. The importance of the system of ensilage to Mr. Swan and other suburban farmers who have little or no arable land, and who sell their milk in the town, can scarcely be exaggerated. If only it relieves them of the necessity of purchasing turnips, mangolds, or other succulent food in the winter,—at a price far above its feeding-value, as is generally their fate,—they can afford a considerable outlay in buildings, and a large expenditure in cartage and labour, for the purpose of converting a portion of their grass, more especially the aftermath, into a succulent food for winter use. Two samples of silage received from Mr. Swan on November 2nd may be reported upon as follows:—the sample from the top contained 77·8 per cent. of moisture and has become somewhat mouldy; that from the bottom of the silo contained 82·6 per cent. of moisture, and, similarly preserved (in a wide-mouth stoppered bottle) is still in a good condition. An analysis of the drainage liquid by Dr. Voelcker yielded the following results:—

The liquid itself contained:—

Water	94·63
Dry residue	5·37
	100·00

The dry residue had the following composition:—

Albuminoids* ..	1·50	or per cent.	27·93
Acids	·88	"	16·39
Extractive matters	1·29	"	24·02
Ash	1·70	"	31·66
	5·37		100·00

* Containing nitrogen ·24, or per cent. 4·47

This material is therefore much richer in albuminous matters and acids than the liquid from Mr. Stobart's silo (p. 165), but it is poorer in extractive and mineral matters.

C. Silage Entirely Chopped.

19. *Mr. J. Ashforth, Longley Hall, Sheffield.*—My silo is 14 feet long, 8 feet wide, and 9 feet deep, below the level of the soil, and on the north side of a hill. It is constructed out of an old stone-built shed, the walls being cemented to a thickness of 1 inch, and the floor stone-flagged. I have made no experiments with uncovered silos. The cost of conversion was 9*l.*, and the silo will last

twenty or thirty years. Filling was done on August 6th, 13th and 20th, cut when about ripe (on the last occasion over-ripe), and chopped to ¾-inch lengths, about 4 lbs. of salt to the ton being added. After each filling I put on the boards and the whole of the weights, namely, 10 tons. I use steel ingots, weighing 50 lbs. each, as they are easy to remove. The object of this immediate weighting was to press the air out as soon as possible. The silo contains about 40 tons of material, and the cost of the labour for filling (three times) was 5*l.* 2*s.*; then the boards cost 10*s.*, and, as I could spare the steel ingots from my works, I only charge the carriage, say, 10*s.* Cutting is done vertically, the same as in the case of a haystack. I use the pitted fodder in the place of brewers' grains for milch cows, and prefer it to grains for forcing milk, and the milk is better in quality. As to its keeping qualities, I find that it can be consumed by degrees without deterioration. I should say that if it has a pressure of about 200 lbs. to the square foot there will be no doubt about its keeping. Mixed with other food I find it an excellent milk-producer. The following are the details of the cost of dealing with the 40 tons of fodder used:—

	£	*s.*	*d.*
August 6, 9*s.*; 13, 9*s.*; 20, 9*s.*; mowing	1	7	0
„ 6, 4*s.*; 13, 4*s.*; 20, 4*s.*; carting	0	12	0
„ 6, 9*s.*; 13, 9*s.*; 20, 9*s.*; chopping	1	7	0
„ 6, 3*s.*; 13, 3*s.*; 20, 3*s.*; pitting	0	9	0
„ 6, 9*s.*; 13, 9*s.*; 20, 9*s.*; treading	1	7	0
„ 6, 13, 20, boarding	0	10	0
„ 6, 13, 20, weighting	0	10	0
Total ..	6	2	0

Making an average of a little over 5*s.* per ton.—*December 7th*, 1883.

I visited Mr. Ashforth on January 26th, 1884; and an inspection of his silo, which contained an excellent specimen of pitted vetches, would lead any one who had compared notes to search for the causes of manifest differences in the measure of success attending the efforts of a number of people with this crop. Vetches appear to be a most difficult crop to preserve by ensilage, probably in consequence partly of the difficulty of expressing the air from between the stalks and pods, and partly of the fact that they are rarely cut until too ripe for a proper fermentation to be set up. Mr. Ashforth, however, had weighted the chopped vetches to the extent of about 200 lbs. to the square foot, in addition to putting with them a certain amount of salt. At any rate, the result was very satisfactory, and seemed to me instructive. On examination in the laboratory, a specimen of this silage was found to contain 78·4 per cent. of water, and a portion of it put into a wide-mouth stoppered bottle kept well from the date of its receipt, December 11th, 1883, until this Report was completed—on March 13th.

20. *Mr. J. Beacock, The Holmes, Winterton Brigg, Lincolnshire.*—The silo is 18 feet long, 10 feet wide, and 12 feet deep, and is constructed above the level of the soil, being part of a well-built barn; the walls are of limestone laid in good lime mortar, and are quite 20 inches thick; they were rather

roughly finished, so I plastered them over with Portland cement and good lime-mortar. I have not had any other experience. The cost was trifling, as the barn was formed ready; the building is a very durable one. The silo was filled on the 16th of July quite full with Italian rye-grass, having a little trefoil in it, cut in the same condition as for haymaking, viz. when done flowering. It was pitted in a chopped state, from ½-inch to ¾-inch lengths. I do not mix anything with the grass or seeds.

The silo was filled at one operation as follows:—In the first place, I had a hired chaff-cutter, and wanted to make the most of it. I also wished to mix the silage with cut straw and wheat-chaff, another reason why I wished to fill it at one operation. I have an idea that it will not be so good where the division takes place, that is, between the operations, because the vapour from fermentation will be sure to condense on the top and spoil some of the grass. The material is compressed first by treading with boys and men; two men with dung-spuds to level it about, and two boys running about actively. When fresh knives are put on the chaff-cutter and oiling is going on, the four men that carry the chaff into the silo go in to tread for five minutes. I cannot give you any idea about the weight that was put into the silo, and shall not be able to tell you what weight comes out. We paid 1*s.* 8*d.* per day for engine and cutter, had four men to carry the cut stuff into the silo at 2*s.* 6*d.* per day, one man at 2*s.* to help to tread down, two boys at 1*s.* each per day, and one man at 2*s.* 6*d.* to tread down. There was a boarded floor to the place or silo, which we hoisted up to the top of the barn by means of pulley-blocks, and left it suspended until the silo was full, then let it down on the grass, and covered it with five loads of burnt soil or brick ashes. The cost per acre may be thus stated:—

Mowing, 2*s.*; carting, 3*s.*; chopping, 5*s.* 5*d.*; pitting, treading, boarding, and weighting, together 3*s.* 9*d.*; making a total of 14*s.* 2*d.* per acre.

My plan of emptying is to have a sort of double doorway filled in with sawdust and movable boards, and, as the silage is cut, I anticipate we shall work into it from below, like tunnelling. We opened the silo on the 29th of November from below, as described above—that is, when the boards were removed, we tunnelled through the silo, and used it up as it dragged out with a dung drag. The results were:—in the first place to prevent the fodder being spoiled by bad weather in trying to make it into hay, and in the next place to have a better and more succulent food for the stock, and thus do away with the almost absolute necessity of using roots, which is expensive, and in wet winters such miserable work on a clay farm, and I think a losing game as well. My experiment was made with rather dry grass, that is to say, the morning was dry, no dew at all when we commenced cutting the grass, and the day continued dry, but without sun, so there was no external moisture on the grass. As to the keeping qualities of the fodder, I think that, if my plan is followed out, to keep the weight on the top, and work from one end, taking what is wanted from the breastwork every day, no deterioration will take place. We were about a month at ours, and we could not tell any difference in it. The horse-feeders would have it for their horses without my consent, and a very careful stockfeeder I have had for years gave it to all the young calves. If the pitted fodder gets air into it, it will begin to must soon, and when once that begins, I believe the must will gradually spread. The whole secret is, I think, in cutting the grass by a hired chaff-cutter, if a farmer has not got one sufficiently powerful of his own, and then treading it down well, and thus getting it as solid as possible; then putting plenty of pressure on it as soon as possible, only removing it as you work from the end. As soon as I opened my silo, I fed two Alderneys on the silage entirely, also some young calves; the other stock was fed with one-third silage, one-third hay, and one-third oat-straw. We had been feeding pulped swedes and

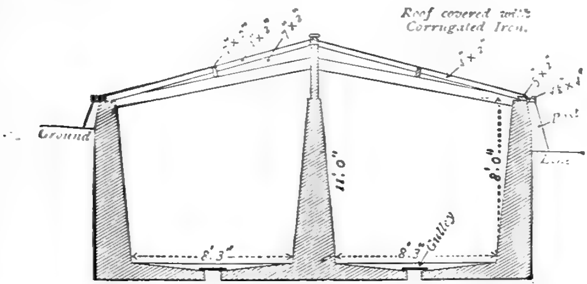
about one-third hay and two-thirds oat-straw cut up into about ½-inch lengths. We could not tell but what the stock did quite as well on the silage as the other food. All have been equally healthy; no purging, nor any symptom of it.—*January 7th*, 1884.

21. *Mr. I. N. Edwards, of Westminster Lodge, St Albans* *:—Three years ago I laid down 30 acres of arable land with grass seeds. The crop this year was very poor, not more than one load to the acre, and almost entirely bents, there being very little undergrass.

In the year 1882 I erected two pits for storing grains, and filled them last year with 100 tons of grains, which came out first-rate; this year, wishing to be in the fashion, I re-named the said grain pits, and they are now called silos.

The two silos are made of bricks, cemented inside and roofed with galvanised iron, and they cost a few shillings under 50*l.* I enclose a section, which will

Fig. 1.—*Section of Mr. Edwards's Silos, showing their sloping sides.*



give the size, &c. They drain into a small cesspit outside. One silo would therefore cost 25*l.*, and this amount, to be repaid within twenty-five years by equal annual payments of principal and interest at 5 per cent., would incur an annual payment of 1*l.* 15*s.* 3*d.*

I decided this year to fill one of the silos with the above-mentioned grass, and accordingly I commenced cutting on the 14th of June, with two mowing-machines, and on the 15th of June the grass was carted and cut into chaff by a steam-engine. The work was commenced at 9.30 A.M., but, in consequence of a severe storm, the machine was stopped at 11.30 A.M., the silo being not quite half full; the 16th was wet all day, and therefore the machine was not started; the 17th was Sunday; and on the Monday, the 18th, the machine commenced at 9.30 A.M., and the silo was completely filled by 2 P.M. Twenty-three men were engaged both on the 15th and 18th, as follows:—

	4 men	treading silo.
	7 „	filling sacks and carrying to pit (about 10 yards).
	1 „	unloading the cart.
	2 „	feeding chaff-machine.
	1 „	engine-driver.
	1 „	waterman.
	7 „	loading carts and dragging.
Total	23 men.	

* This account of Mr. Edwards's practice is reprinted from the 'Live Stock Journal' of July 30th, 1883.

The men were engaged for three hours on the 15th, and 4½ hours on the 18th, at 3*d.* per hour. Three horses and carts were employed. It took 6½ acres of the grass to fill the silo, and the grass weighed 15 tons 5 cwt., 2 lbs. of salt being added to each cwt. of grass.

The following was the cost of filling the silo:—

	£	s.	d.
June 14th, 1883, mowing 6½ acres of grass with machine, including beer for men, but exclusive of horses, 1*s.* 8*d.* per acre	0	10	10
Raking three rows into one, putting into small cocks for carting, and breaking salt, including beer for men, 2*s.* 5*d.* per acre	0	15	8½
June 15th, 23 men, three hours each, at 3*d.* per hour, carting, cutting chaff, and pitting, including beer (but exclusive of horses)	1	0	2
June 18th, 23 men, 4½ hours, at 3*d.* per hour, ditto ..	1	10	8
Paid for steam-engine and chaff-cutter, 7½ hours, at 3*s.* per hour	1	2	6
Five cwt. of coal	0	4	4½
Five and a half cwt. of salt	0	6	0
	£5	10	3

Average per acre, 17*s.*

The top of the grass in the silo is covered with thick wooden doors, on the top of which is placed 1 ton 3 cwt. of old iron gas-pipes, and twenty American flour-tubs filled with the same description of chaff as in the silo, each tub weighing 85 lbs. The doors weigh about 2 cwt., thus making a total weight of 2 tons.

My object in using the flour-tubs was to ascertain if the grass would keep good in them; because, if so, the weights to be placed on the silo will not only be easily obtained, but at the same time will be serviceable and cheap. Following is an account of the cost of the covering and weights on the top of the grass in silo, viz.:—

	£	s.	d.
Doors	0	15	0
Twenty tubs, at 1*s.* 4*d.*	1	6	8
1 ton 3 cwt. of iron	2	6	0
	£4	7	8

The above, to be repaid within five years by equal annual payments of principal and interest at 5 per cent., would incur an annual payment of 1*l.*

I placed a thermometer on the top of the boards under the iron roof and examined it daily, and at the same time ascertained the sinking of the grass.

	Thermometer.	Sinking.
June 19	64	None.
,, 20	60	A little in centre.
,, 21	62	3 inches in centre.
,, 22	72	Do. do.
,, 23	72	1 inch in centre.
,, 24	74	1 inch in centre and 1 inch outsides.
,, 25	74	1 inch in centre.
,, 26	72	Do. do.
,, 27	68	None.
,, 28	69	None.
,, 29	70	1 inch in centre and 1 inch outsides.
,, 30	69	None.

Total, 11 inches in centre, and 2 inches on the outsides.

The remainder of the grass was made into hay, namely, 23½ acres.

	£	s.	d.
June 14th, 15th, and 16th, 1883, mowing 23½ acres with machine, including beer for men (but exclusive of horses); all men were paid 3*d.* per hour while at work	1	19	2
19th, Eleven men haymaking, including beer	0	15	8½
20th, Nine men do. do.	0	4	9
22nd, Sixteen men haymaking and carting, including beer (but exclusive of horses)	0	17	9
„ Fifty faggots for bottom of rick	0	7	6
„ Six truss of straw for rick bottom	0	5	0
23rd, Twenty men haymaking and carting, including beer	2	18	8
25th, Nineteen men do. do.	1	9	7½
26th, Four do. haymaking	0	5	4
27th, One man do.	0	3	0
28th, One do. do.	0	1	4½
29th, Nine do. do. and carting	1	3	7
30th, Men pulling rick and making good for rough thatching	0	7	6
30th, Paid for rough thatching and beer	0	5	0
„ 1½ loads straw	2	14	0
„ Thatching for good	1	0	0
„ Wear and tear of rick cloths and elevator	1	0	0
„ Insurance of hayrick	0	5	0
	£16	2	11½
Estimated cost of cutting 23½ loads of hay into chaff by steam, including men, beer and coal	9	12	6
Eleven cwt. of salt	0	12	0
	£26	7	5½

Cost per Acre—Silo versus Haymaking.

Silo.	£	s.	d.	Haymaking.	£	s.	d.
Cost of filling silo as per account per acre	0	17	0	Haymaking as per account per acre	0	13	9
Moiety of cost of building 2 silos, including interest at 5 per cent., principal and interest to be repaid in 25 years (per acre) ..	0	5	5	Estimated cost of cutting the said hay into chaff, and storing as per account per acre	0	8	8¼
Cost of covering and weights on the top of grass, including interest at 5 per cent., principal and interest to be repaid in 5 years (per acre) ..	0	3	1				
Total per acre	£1	5	6	Total per acre	£1	2	5¼

I have not included any charge in the above for horses, as they are kept on the farm all the year round, but if charged, the amount would have been as follows:—

	Silo per Acre.		Haymaking per Acre.	
	s.	*d.*	*s.*	*d.*
Horses charged at 6*d.* per hour while at work mowing, per acre	1	8	1	8
Carting, dragging, and using elevator for hay, per acre	1	4	2	10
	3	0	4	6

The Weather during the Period.

June 14, 1883.	Fine all day.
„ 15 „	Dull; began to rain at 10.30 A.M. A storm at 11.30 A.M.
„ 16 „	Showers all day.
„ 17 „	Slight showers at intervals.
„ 18 „	Dull, but no rain.
„ 19 „	Ditto.
„ 20 „	Fine up till 11 A.M.; then showers all day.
„ 21 „	Showers all day.
„ 22 „	Fine up to 3 P.M., and then rain for rest of day.
„ 23 „	Fine all day.
„ 24 „	Rain at 8 A.M. and 11 P.M.
„ 25 „	Dull morning. Rain from 3 P.M. to 6 P.M.
„ 26 „	Showers all day.
„ 27 „	Dull morning. Showers from 1 P.M.
„ 28 „	Showers all the morning.
„ 29 „	Fine all day, but a severe thunderstorm at night.

From the above it will be seen that I was blessed with the usual wet weather, namely, out of sixteen days eleven were wet.

Although the cost per acre is a little more for the silo than for haymaking, the silo, being independent of the weather, will more than counterbalance the difference, provided the grass in the silo turns out well.

Mr. Edwards has kindly sent me the following account of the opening of his silo on the 4th of December, 1883, when I was present:—

I opened my silo yesterday, in the presence of Sir J. B. Lawes, Dr. Gilbert, Dr. Voelcker, Messrs. Walter Gilbey, John Thornton, H. M. Jenkins, and others. On removing the corrugated iron roofing, we found that the wet had been entirely kept out, and on taking away the boarding, we discovered that the surface of the silage for a depth of 6 inches was rotten, that the next 12 inches were mouldy, and that the silage from that depth was good, and gave off a pleasant aroma. The grass having consisted entirely of bents, it was not so moist as is usual for silage, and I think the bents when cut must have been a little too ripe to ensure perfect silage.

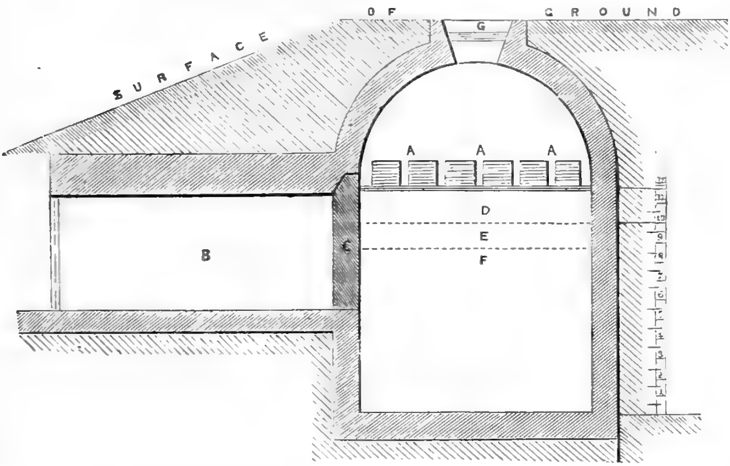
However, I look upon the experiment as a success, and I hope from the lesson I have learnt to benefit by it next season. A portion of the rotten and mouldy silage, and a portion of the good, were given to the cows, and they ate it with a relish which astonished all present.

The foregoing account of the condition of the silage is quite in accordance with my own notes. The cause of so much mould and waste is not far to seek. A glance at the section of the silos (Fig. 1, p. 171) will show that they have sloping sides, and therefore the weighted doors could not follow the pitted fodder as sinking progressed. This was evident as soon as the arrange-

ment was seen, owing to the curious inequalities of surface which the doors presented. A sample sent to the Laboratory on December 5th was found to contain only 51·1 per cent. of water. It need scarcely be added that although it was very dry, it rapidly went mouldy.

22. *Lord Egerton, of Tatton, Tatton Park, Knutsford, Cheshire (per Mr. J. T. Smith, Estate-agent).*—The silo is an old ice-house in the Park, and was considered a good place for an experiment. The walls on the inside were plastered with cement; the present entrance blocked up, and a new entrance made in the centre of the dome, all as shown by the Section accompanying this.

Fig. 2.—*Section of Lord Egerton's Silo at Tatton Park, showing its condition at the end of the third day's work.*



A, A, A. Boxes filled with bricks.
B. Archway from the side of the bank, by which the silo is emptied.
C. New brickwork.
D. Height at which silo was finally weighted and settled; condition of grass, juicy and damp with dew.
E. Section of grass quite dry and top grass dead.
F. Height to which grass put in on first and second fillings had sunk to when opened on July 27.
G. Man-hole used for filling.

The following are the dimensions of the ice-house :—

Diameter, 11 feet 6 inches; height to square, 12 feet 6 inches; area, 104 square feet.

A portion of the Park fenced in and near the ice-house, and which often had been mown without a fair proportion of keep, was chosen as suitable. Though amongst it there was a proportion of fine grass, the greater quantity was rough and coarse. The process of filling the silo may be thus described :—

July 3.—This day portable engine, chaff-cutter, and all other necessaries were on the ground.

July 4.—At 8.15 our mowing-machine started, and at 9 our first load of grass left for the silo, the chaff-cutter being got to work at 9.15. The first hamper when cut weighed 43 lbs., the same hamper filled with whole grass weighed 38 lbs.; this quantity took 40 seconds to chop; if grass is cut wet

the weight of the hamper would be 65 lbs. This day 370 hampers were filled in, and our average weight was 53 lbs., thus giving a total of 8 tons, 16 cwt. 1 qr. 10 lbs. put in the silo; in addition to this, salt was added at 1 lb. to the cwt. = 176½ lbs. = 1 cwt. 2 qrs. 8½ lbs. Every tenth hamper of cut grass was weighed. The grass was cut in lengths of from ½ to 1 inch. The labour employed was one man and two horses mowing; one man sharpening and assisting to fill the carts; two men with carts, and two horses carting the grass from the field to the silo. Two men and two women in the field raking and cleaning the ground and loading the carts. At the silo one man was driving the engine, one feeding the chaff-cutter, and one man supplying him. Three men were treading the cut grass in the silo, one man was spreading grass and salting it; two men and one boy were fixing hampers and removing them from the chaff-cutter, weighing the same and also salt, and lowering all into the silo. Stopped work at 7 P.M. with 8 feet of grass in the silo, weighing 8 tons 16 cwt. 1 qr. 10 lbs. Stopped three hours during the day for meals, and the work all day only proceeded slowly, as all information had to be accurately taken, and much time was therefore lost. From 7 to 8 P.M. our weights were put on, after covering the surface with 1¼ inch boards; our weights were thirty boxes, made of 1¼ inch wood with handles of rope, each box being 1 foot 10 inches long, and 1 foot 5 inches wide by 1 foot 5 inches high, and contained thirty bricks: each box and bricks being in weight about 2½ cwt., the total weight, with boards, was about 4 tons. Two and a half acres of grass were mown this day.

July 5.—The weights were lifted out of the silo in half an hour. Mowing commenced at 8 A.M., and the first load of grass was at the silo at 8.20. This morning we found that the silage had sunk during the night, and with the weights, to the extent of 1 foot; therefore the refilling began at 7 feet. The same mode of operation was followed this day, 169 hampers being put in the silo, averaging 58 lbs., and giving a total of 4 tons 7 cwts. 0 qrs. 18 lbs., which added to July 4th total, gives total weight of grass in the silo 13 tons 3 cwt. 2 qrs. Salt was used this day at the rate of 1 lb. to the cwt. of grass, thus 87 lbs. added to the 176, put in on the 4th, gives a total of 263 lbs., or 2 cwt. 1 qr. 11 lbs. The mowing-machine stopped this day at noon, and the chaff-cutter at 2 P.M. One and a half acres were mown this day. The same number of hands were employed at the silo, but three extra men were in the field loading grass. Boards were put on as before, and afterwards 6 inches bran, costing £3 10*s*., and then the boxes of weights. The crops realised about 3 tons 1 cwt. per acre, and if made into hay they would have produced about 15 cwt. per acre.

	tons.	cwts.	qrs.	lbs.
Total weight in silo, grass	13	3	2	0
salt		2	1	11
	13	5	3	11

July 6.—At noon the grass level was 10 feet, showing a sinkage of 2 feet 6 inches.

July 7.—At 8.30 A.M. the grass-level was 9 feet 6 inches, showing a sinkage of 3 feet.

July 14.—At 8.30 A.M. the grass-level was 8 feet 6 inches, showing a sinkage of 4 feet.

July 27.—Boxes of weights and bran were cleared out of the silo; mowing again commenced at 9.30. Silage was found to be brown and quite sweet, though it was slightly warm. Same mode of operation as before was followed. The grass mown was about 1¼ acres, and the weight put in the silo 3 tons 5 cwt. 2 qrs. 6 lbs., and ½ lb. of salt to each cwt. = 33 lbs. 151 hampers averaging 48 lbs.

	tons	cwt.	qrs.	lbs.
Total weight at completion, grass	16	9	0	6
salt		2	2	16
Total weight in silo ..	16	11	2	22

Total acreage mown, July 4	$2\frac{1}{2}$
" " " July 5	$1\frac{1}{2}$
" " " July 27	$1\frac{1}{4}$
Total ..	$5\frac{1}{4}$

Cost of Filling Silo, Tatton Park.

1883		£	s.	d.
July 4.—	One man driving, and for hire of engine	0	13	6
"	One man feeding chaff-cutter	0	3	6
"	One man supplying him	0	3	6
"	Three men in silo treading and tramming	0	12	0
"	One man in silo spreading and salting	0	4	0
"	Two men and one boy placing and removing hampers, weighing grass and salt, and filling silo	0	8	6
"	One man and two horses mowing, and machine	0	15	0
"	Two men and two horses leading grass from field	0	14	0
"	Two men getting grass together in field	0	7	0
"	Two women raking, &c., in field	0	4	6
July 5.—	One man and engine	0	13	6
"	One man half day feeding chaff-cutter	0	1	6
"	One man half day supplying him	0	1	6
"	Three men in silo three-quarters of a day	0	6	9
"	One man in silo spreading and salting	0	2	3
"	Two men and one boy as above	0	5	$7\frac{1}{2}$
"	One man and two horses mowing, and machine half day	0	7	6
"	Two horses and two men carting	0	7	0
"	Two men loading grass in field	0	3	0
"	Two women " " "	0	4	0
"	Three men " " " and raking	0	4	6
"	29 lbs. cheese, at $8\frac{1}{2}d.$ = £1 0*s.* 7*d.*, and 56 lbs. bread, at $1\frac{1}{2}d.$ = 7*s.*	1	7	7
"	36 gallons beer, at 8*d.*	1	4	0
July 27—	Engine and driver	0	12	0
"	Four men in silo	0	14	0
"	Seven men in field	1	1	0
"	$14\frac{1}{2}$ lbs. cheese = 10*s.* $3\frac{1}{2}d.$; 28 lbs. bread, 3*s.* 6*d.* ..	0	13	$9\frac{1}{2}$
"	Beer, 12 gallons	0	8	0
"	Mowing machine, half day	0	7	6
		£13	10	6

August 20.—This date level of silage stood at 9 feet 6 inches, having sunk 2 feet 3 inches since last filling.

	£	s.	d.
The boxes and bricks would be worth	6	15	0
The covering of boards	1	0	0
Total ..	£7	15	0

The fodder is taken from the silo in layers, after having been cut with an ordinary hay-knife. This expense is but small, as it is done in the ordinary

course of work. We have found that the grass can be preserved, but we are only now testing its feeding and other properties.—*February 20th*, 1884.

I have given the above details in full, because they are the first step in a careful experiment, showing exactly what was put into the silo; as will be seen in Mr. Smith's letter of March 12th, it corresponded exactly with the weight of silage taken out. Mr. Alfred Smethum (an old assistant of Dr. Voelcker) has been engaged in making analyses of the grass put in and of the silage taken out, and his report, given on p. 380, will aid greatly in throwing light on the chemistry of ensilage.

Writing on March 8th, Mr. Smith stated:—

"Our silage was perfectly good to within some nine inches of the bottom; on arriving at this level we found it was heavily saturated with liquid, and when a small truss of this was lifted outside it was marvellous to see the rapidity with which the liquid ran away. It was of a very dark brown colour, and smelt like the odour you have from vinegar. Of course the silage you saw was very moist, but this at the bottom would not take in any more moisture than it had; and I cannot help but think that the proper course is certainly to have some drain away from the silo, with a syphon attached from a small cesspool, which, of course, should be arranged so that no air could pass, and then I feel positive that the silage would be perfectly good on our system from the top to the bottom of the silo. I think you saw that our sides were good, and though this silage at the bottom, which is so saturated, is sound, yet I must say it is much too strong to give to animals."

In reply, I discouraged Mr. Smith's idea of any drain or siphon. My idea of what a silo should be, put in homely language, is simply—an agricultural jampot; without drainage, and perfectly impermeable to air and water at the bottom and sides, and with only sufficient vent above to allow of the escape of gases, while being practically protected from any accession of air or water from without. Wetness of silage is sometimes greatest at the bottom, sometimes at the top, and sometimes at varying points or strata in between. It is sometimes due to the nature of the crop (such as prickly comfrey), sometimes to its too saturated condition when pitted, sometimes to the effect of moisture being enhanced by an addition of salt, and sometimes to infiltration of water into the silo from outside. Investigation in each case can alone determine the cause, and point to the proper remedy, which I do not believe ought to be the drainage of the silo in any case.

Mr. Smith thereupon further wrote to me on March 12th as follows:—

"I quite agree with you that the excessive moisture at the bottom of our silo is undoubtedly caused by the admixture of salt with the grass when it was pitted; and besides this, with the heavy weight on the silage, of course a large proportion of the moisture would settle at the bottom of the silo. With our 16 tons of silage we put away not more than 2½ cwt. of salt, so

you will see it is but a small proportion. Yet this would give to the silage at the bottom of the silo a very strong flavour, and leave the silage in a much stronger state than I dare venture to give it to the cattle. You will be pleased to hear that our actual weight out of the silo corresponds exactly with the weight we put into the same. The cubic foot at the bottom weighed heavier than I expected, but this is simply accounted for by the existence of the moisture, so you will see that as there is no drain to the silo there is not the slightest loss. I have no doubt if a drain had been laid we might have lost 5 or 6 cwt., or, perhaps I ought to say, more; because, not only would the salt, being soluble, have gone, but no doubt with the excessive weight some moisture out of the grass would have found its way through the syphon, which we should try to keep."

23. *Earl Fortescue, Castle Hill, South Molton, Devon.*—My silo is 19 feet long, 6 feet 9 inches wide, and 5 feet 3 inches deep, and its cubic capacity is 673 feet. It is above the level of the soil, and has four stone walls—three existing walls utilised, and only the fourth built—the sides and bottom being cemented. It has no drain, and it is roofed with movable sheets of corrugated iron. It actually cost 11*l.* 10*s.*, including everything—all the materials, labour, &c., of which labour came to about two-fifths. On the 25th of July it was filled with the grass of about 1 acre of an unwatered meadow left for hay, when still green and not too ripe to make good hay; ten days later, after the silage had subsided about a foot, it was filled up with coarse grass from an orchard. The grass, a heavy crop, was still wet at the bottom from recent rain, though the day was dry when it was mown, when it was cut by a chaff-cutter into about $\frac{3}{4}$-inch lengths, and put into the silo immediately afterwards. When the silo was full, ploughed and tongued boards were placed upon the mass, and sawdust and large stones on the top of them, so as to give a pressure of about 50 lbs. to the square foot; the boards, sawdust, weights, and roof were replaced upon it, and it was left until opened—December 20th.

The grass from the meadow and the orchard was considered to be the produce of about $1\frac{1}{4}$ acre, which it was estimated would have yielded about 2 tons of rather coarse hay. When the silo was opened the silage had shrunk about a foot, and occupied about 513 cubic feet, and its weight was about 36 lbs. to the cubic foot; it was found about as moist as when it was put in. The entire cost for labour in cutting, filling. &c., was 37*s.*, of which the cutting to chaff cost 8*s.* It is not yet quite emptied. It is cut down vertically, like hay from a stack.

All the cows eventually took to it, and so did the horses greedily after a day or two, and seemed to do well on it.

As to the keeping qualities, we found that if left about long after being cut, it became mildewed: it therefore required to be eaten within 2 or 3 days; but the face of the silage left in the silo after each cutting does not seem to change for 8 or 10 days. The cows, which received daily $33\frac{1}{3}$ lbs. of silage instead of 12 lbs. of hay, but had 2 lbs. of oilcake, 2 lbs. of undecorticated cotton-cake, and 2 lbs. decorticated and 2 lbs. of pollard and $5\frac{1}{3}$ lbs. of straw-chaff besides, kept their condition, and gave a slight increase of milk and butter of hardly appreciably deteriorated quality from what they had given before that substitution: but the cows with 50 lbs. of silage substituted for the hay and straw-chaff (the cake and pollard remaining the same), went back in condition, and gave slightly less milk and butter than before, and that of decidedly inferior quality.—*January 30th*, 1884.

Earl Fortescue's experience, it will be observed, differs from that of several experimenters, but agrees with that of Mr. Gibson

(see below) and others; but it should be remembered that the silo was not opened until nearly Christmas time, when the yield of milk under ordinary circumstances in England rapidly diminishes in quantity and deteriorates in quality. The sample of silage sent to me by Earl Fortescue was in a cardboard box, and was shown to a number of "amateurs" of the system from time to time for several weeks, during which it retained its remarkably sweet fragrance, and showed scarcely a sign of mould.

24. *Mr. Edmund B. Gibson, Saffron Walden, Essex.*—The principal silo is 60 feet in length, 12 feet in width, and 17 feet deep—10 feet of the depth being below the level of the soil. It is divided into five compartments which open into each other. I have two others formed by bricking up the bays of barns. The principal silo is built of cement concrete, the walls and partitions are all 9 inches in thickness, covered by a galvanised-iron roof formed with frames on hinges which are raised by means of pulley-blocks. In my opinion, silos made without a wet-resisting roof must fail. The cost of the silo first mentioned, including 5 tons of cement weights, was 230*l.*, exclusive of the 1½-inch battens for covering the pitted material. It will last an indefinite period. The silos were filled at intervals as the green crops became ready. The chief silo being in compartments, this could easily be done without disturbing the fodder when once covered and weighted. The crops preserved have been rye, tares, sainfoin, clover, trefoil, and grass; they have been cut when in flower, and pitted after having been chopped into half-inch lengths. Not any foreign material is mixed with the fodder; if salt is added it of course liquifies and tends to make the fodder mouldy; by adding straw, air is introduced with the same result.

The mode of procedure is as follows: The fodder is carted as soon as cut, and passed through an ordinary chaff-cutter, shot into the silo, and well trodden down. The first portion of the material is allowed a short time, say 12 hours, to settle; in the meantime it is temporarily covered over with the battens, which are subsequently used for the final sealing down. For that purpose they are dowelled one into the other, so as to sink bodily like a floor under the weights (about 15 cwt. to each compartment) which are placed upon them. The dowelled joints are covered by strips of felt, and a thin narrow piece of deal is nailed above the felt to assist in the exclusion of the air. The weights are sufficient to keep the batten cover in close contact with the fodder, and to insure its sinking as compression takes place. This summer I have pitted about 400 tons of green food, the produce of 52 acres.

The expense of filling varies with the nature of the fodder and the amount of compression—thus an acre of green rye will occupy a much larger space than an acre of clover or sainfoin; but I should put the expense at from 2*s.* 6*d.* per ton. My mode of emptying the silo is to take the fodder from the top for use, and thus the surface is only exposed for a few hours. By the process of ensilage, I have effected (year 1882–83) a great saving in purchased food, owing to the increased quantity of natural food produced on the farm, and my ability to return nearly all the straw to the land in the form of manure, thus saving artificial manure.

The result of feeding cattle on pitted fodder in my case has been that two bushels of ensilaged rye mixed with one bushel of swedes produced the same quantity of milk as one bushel of ensilaged rye and two bushels of swedes, both being used in conjunction with 3 lbs. of cotton-cake per head per day. The fodder should be consumed as the animals require their daily food when once begun; it will turn mouldy on the surface after three days' exposure to the air.

If, however, it is compressed by hydraulic or other strenuous means it may remain comparatively uninjured, as the air will not so easily penetrate the mass. I used ensilaged rye daily from October 1882 to March 1883 for milking cows, consuming about 80 tons, in conjunction with swedes, mangolds, and 3 lbs. of cotton-cake per head per day. My silo was built in 1881, but it was filled the first year with brewers' grains.—*August* 18*th*, 1883.

Composition of a Sample of Clover and Sainfoin Ensilage sent by Mr. Edmund B. Gibson.

Soluble in water 70·36 per cent.:—	
Water	57·55
Soluble albuminoids	3·43
Acetic and other volatile acids	·28
Lactic and other fixed acids	·76
Soluble non-nitrogeneous compounds	6·11
Soluble mineral matter	2·23
Insoluble in water 29·64 per cent.:—	
Insoluble albuminoids	4·44
Crude vegetable fibre	23·32
Insoluble mineral matter	1·88
	100·00
Total nitrogen	1·26

November 12*th*, 1883. (Signed) Augustus Voelcker.

PS.—Since writing the foregoing I have had ample opportunities of testing the feeding value of silage, as it has formed the staple food of eighty head of horned stock since the middle of October last.

Mr. H. M. Jenkins saw the first section of the silo uncovered, and the silage was found in excellent preservation, with the exception of 2 inches on the surface, increasing gradually towards the sides for 2 feet down, when the mouldy portion ceased.

The allowance of food for each cow in milk per day is as follows:—

	lbs.
Clover silage	22
Rye silage	26
Straw chaff	5
Hay chaff	5
Barley or maize meal	3
Roots (3 pecks)	45
Total weight	106

I find this combination the most economical and conducive to a full flow of milk, keeping the cattle in excellent condition.

Now as to the cost of cutting and pitting the fodder. I am unable to give the cost of each operation, but can estimate with accuracy the cost of preserving a ton of silage. A cubic foot weighs 45 lbs., and my five pits consequently hold 50 tons each.

	£	s.	d.
It took two and a half days to fill a pit, at a cost of 3*l.* 10*s.* per day, giving exactly per ton	0	3	6
The cost of cutting, 2*s.* 6*d.* per acre, or per ton	0	0	6
The cost of the covering boards is 1*l.* 6*s.* for each pit containing 50 tons, or per ton	0	0	6
The cost of securing boards and placing weights in position, per ton	0	0	1
Total per ton	£0	4	7

February 26*th*, 1884.

Mr. Gibsón's description of his silos requires very little explanation, but I ought to point out some features in them which may possibly excite criticism. First of all, it should be stated that although the corrugated-iron roof is necessarily in sections, owing to the length of the row of silos, under the margins of two adjoining sections is a galvanized-iron furrow, which performs the double duty of a resting-piece and a drain to carry off rain-water. These sections of the roof are really flaps on hinges, and are opened by raising the lower edge by means of a portable pulley and rope at the end of a pole. When raised enough, their position is maintained by fixing in a couple of rods into holes on the top of the silo wall, and into sockets in the galvanized-iron flap. The covering of the silage is most completely done, but, as I could not help remarking, at what seemed to me too great a cost. The dowelling of the boards, the cost of the felt, and then that of the battens, with nails and labour, both in putting on and almost more in taking off, must make up a rather considerable sum. Still, Mr. Gibson was of opinion that the outlay was remunerative, because it saved waste of material. Mr. Gibson also piles a quantity of cavings above the boards and weights, with a view to assist in excluding the air from the silage. The silo which I saw opened on October 10th, 1883, contained chopped clover, which had been put in about the beginning of July, and had therefore been in about three months. The top of the fodder was mouldy only to the depth of $1\frac{1}{2}$ to 2 inches, and the sides close to the outside wall were also damaged, but only to the thickness of $2\frac{1}{2}$ inches. The remainder was perfectly good, but apparently had not gone much beyond the alcoholic fermentation. The smell was strongly that characteristic of aldehyd in silage. As Mr. Gibson states above, the pitted fodder goes mouldy in three or four days. In some other silos Mr. Gibson has green rye sown after harvest, and followed in the spring by turnips. Altogether he has 400 tons of fodder pitted. The great disideratum here was a machine for elevating the cut fodder into the silo, because at present it has to be carried up several feet. Mr. Gibson has the credit of being one of the first men in England to put the system of ensilage to the test under the "*nouveau régime*," and therefore the results of his experience are entitled to great weight:—he considers that the use of silage does not increase the flow of milk, and he has found that it does not pay to feed cows entirely upon it, as it has too costive an effect; but he has not found the use of it interfere with the breeding-properties of the cows, or otherwise be detrimental to their health. He has successfully fattened cattle entirely on silage and an allowance of linseed-cake. Two samples of his silage were sent by Mr. Gibson to the

Society's Laboratory at different dates. The analysis of the first, sent on November 12th, 1883, is given above; it contained only 57·55 per cent. of water, and went rapidly mouldy. The second, sent on January 2nd, 1884, contained 75·6 per cent. of water, and kept fairly well in a wide-mouth stoppered bottle; but the remainder, left in the tin in which it had been sent, soon became mouldy.

25. *The Duke of Hamilton (per Mr. David Smith, Agent), Easton Park, Wickham Market, Suffolk.*—The silos are each 22 feet long, 8 feet wide, and 10 feet deep, and are above the level of the soil. They are constructed in the bay of a barn, and the walls are of 14-inch brickwork, coated with cement, with a wooden curb on the walls. The floors are of concrete, also coated with cement. I have made no experiments with silos not covered with a permanent roof. The first cost of the silos was about 36*l.* I should imagine at the end of fifty years they will be as good as they are now. One was filled the end of June, and filled up again three weeks after the first filling; the other was filled the beginning of August, and filled up again about a month after. The crops were clover and rye-grass from the first growths in the first filled, and from a second growth in the second; and they were cut when they were fit for making into hay. They were pitted in a chopped state (average length, 1 in. to 1½ in.), and part of them during a drizzly day. Salt at the rate of about 1½ lb. per cwt. of grass-chaff was mixed with it, in order to give the food a greater relish. The silos were filled in two operations, about three weeks intervening between each operation in the one case, and a month in the other. I think they might have been advantageously filled a third time.

At the close of each filling, a layer of bran about 3 inches thick was placed upon the grass-chaff, upon which were laid some doors, six of 8 feet by 3 feet 8 inches, and each door was weighted with 500 white bricks. The amount of pressure thus applied was about 9 tons upon each silo, which will remain upon the silage until it is wanted for use. I imagine the weight of the crop per acre was about 3 tons, and the produce of about 15 to 20 acres was used to fill the two silos. The expense in labour of filling the silos, including cutting and chaffing the crops by steam-power, was about 15*s.* per acre; the bricks cost about 50*s.* per thousand.

As the silos are by the side of the floor on which the cattle food is all mixed, the silage will only be removed as it is required, so the cost of emptying has not been gone into. We propose cutting the silage down vertically, like a haystack. One result we obtained by pitting our grass fodder was to secure the crop without risk of being spoiled, besides having a much greater quantity of better food than if it had been made into hay. The silos have only been opened about a week. The cattle seem to enjoy the silage mixed with the pulped roots and chaff, and look to have wonderfully improved in the week they have been feeding upon it. I shall not use more than half the quantity of salt when the silos are next filled, as the cattle at present consume more water than I think is good for them.—*January 29th,* 1884.

A sample of this silage sent to Hanover Square for examination kept remarkably well in the box in which it was sent for several weeks. By calculation, it will be found that the pressure applied is about 1 cwt. to the superficial foot.

26. *Mr. H. Hoare (per J. Austen, Farm Bailiff), Pagehurst Farm, Staplehurst, Kent.*—We first built one silo 20 feet long, 10 feet deep, and 10 feet in width, divided into two, so that they were each 10 feet square. It is built with bricks and mortar, and faced with cement, paved at the bottom and cemented. The cost of building the silo was about 50*l.* I have said before that it would last forty years, but I do not see why it should not last eighty years, it being under a covered roof. The second one was built the same size, adjoining the other, so there would be one wall common to the two, and therefore the cost of the second silo would be only 40*l.*, which is easily understood, it being all 18-inch work. We first filled the silo with trifolium cut up with a horse chaff-cutter, and trodden in evenly and well. Then a little straw, about as thick as your hand, was placed on the top of the fodder before the planks, which were loaded with about 50 lbs. to the square foot, including planks, care being taken to load the ends of the planks well; then the food will come out well. I have pitted vetches in just the same way, also clover and rye-grass, which all came out well. I have some maize in now, and it keeps very well indeed. I feel sure that if the food is put in evenly, 50 lbs. per foot is sufficient weighting, that is to say, if it is kept air-tight; but if the fodder is put in without cutting, no doubt it would require more weight. I believe in filling the pits as quickly as possible after they are begun, as it is less expense and better for the fodder. I have filled seven pits now in all, and I find 3 inches to the foot is an average shrinkage after it is sealed in. All fodder wants cutting before the bloom falls; if it is too old and dry, I find it does not ferment properly. As regards the cost in filling; an average distance from the field to the pit would be 200 yards, that would be on a farm of 200 or 300 acres. To fill one silo, 2000 cubic feet, the cost would be as follows:

	£	*s.*	*d.*
Mowing	1	5	0
Carting	2	14	0
Cutting with horse	0	18	0
Putting in silo	0	9	0
Spreading it over and treading in silo	2	5	0

This expense* will include putting on planks, stones, or whatever the covering may be. Cost of planks, 3*l.* 1*s.* 6*d.*; stone, 1*l.* 10*s.*

The dates of filling were June 29th, July 13th, and October 8th. The pitted fodder is cut down in cants as it is used, like a load of hay, and I believe it will produce more milk and butter than if preserved in any other way. I prefer putting the crop in the silo when dry, but it will keep if this is not done. If taken out in cants, my experience is that it will keep without being rapidly consumed, if it has been sufficiently pressed. My experience has not been large. I used the fodder last year partly as it was and partly mixed with dry food, and I found that the stock did well upon it.—*Nov.*, 1883.

I visited Mr. Hoare's farm on November 20th, 1883, and found that Mr. Austen had opened and cut down for about six feet in depth the silo containing the vetches. The silage was excellent in every way except a few inches at the top, which was mouldy, and the straw covering under the boards was very wet, and apparently rather tended to increase the depth of mouldy material.

* This amounts to about 7*s.* per ton, chiefly on account of the expense of carting.—H. M. J.

The silo containing chopped clover was opened in my presence. It had been covered and weighted in the same way the other one, but had been overfilled by means of temporary boarded sides, so that the compressed material was quite at the level of the top of the silo. Whether this had had any effect I cannot say, but Mr. Austen seemed to think it had. At any rate, nearly nine inches of the top was more or less mouldy, and the clover beneath was very dry and only slightly fermented. Mr. Austen was very much astonished at this result, which was probably due to the dryness of the clover when it was pitted. Of the samples of the three kinds of silage sent to Hanover Square, it may be recorded that the maize went rapidly bad, the tares kept best, and the grass fairly well.

This case is an interesting illustration of the fact that different crops, and even the same crops under different circumstances, require variations in treatment in order to convert them into good silage.

27. *Mr. C. Hunting, South Hetton, Fence Houses, Durham.*—My silo is 40 feet long by 12 feet wide, and 10 feet deep, and is 4 feet below the surface of the soil. It is constructed with white post stone, and faced with pressed bricks laid in cement; with a concrete floor covered by cement. A drain is cut all round it—inside—3 inches from the wall. The walls are 2 feet thick, and covered with a corrugated-iron roof, 3 feet from the top of the wall to the eaves. The entrance is 4 feet wide at the south end, to admit a horse to tread its contents, and also for a tramway to bring the silage to the byre. Its first cost was about 100*l.*, and I should expect it to last a century.

Filling the silo commenced on the 23rd of September, and finished on the 2nd of October. It was filled to within 1 foot of the top, when the "cutter" broke, so we closed it up. The first two days we put in 13½ acres of good second-crop clover, cut into chaff. The eighth day about 20 loads of beans, peas, and tares; and the next day we filled the silo within a foot of the top with about half beans, peas, and tares, and half second-crop clover, cut up and mixed together. The crops were all unripe, except the beans, peas, and tares, which had been cut several days, trying to win them for stacking; but the constant wet spoiled them for that purpose. All the material was chopped about half an inch long, and no salt or condiment of any kind, neither straw, was mixed with the fodder. The method of filling was as follows:—

Two days first filling, then put on weights for seven days, then filled again, weights put on and closed. I allowed seven days to elapse, after the first filling, for the silage to settle down, and from 8 feet, it subsided 14 inches only, which I thought was owing to the 16 cwt. horse treading it down. The second filling, in which no horse was employed, but seven women, two men, and two lads, subsided, in the same number of days, more than one-half.

When filled, we put on boards 2 inches thick, and as long as the silo is wide, and 9 inches broad; upon these we placed 22 tons of iron blocks, and 8 tons of sand in guano-bags.* Seventy tons of fodder were put in, and it is cutting out, at the lower part trodden by the horse, 50 lbs. to the square foot, and at that part trodden by men and women, only 40 lbs. per square foot. The expenses of filling were as follows:—

* Making altogether 1¼ cwt. per square foot.—H. M. J.

	£	s.	d.
Cutting into chaff, treading, and packing it	2	15	6
Weighting with 30 tons of iron and sand—in bags—on twice, and taking off once	2	0	0
Fixing cutter on platform, and taking it back to its original position	0	14	0
Engineman and coals	1	2	0
In the fields—cutting, raking, and leading crops to silo—10 men, 2 women, and 12 horses	9	2	0
	£15	13	6 *

The pitted fodder is cut vertically, the same as hay out of a stack, removing two boards, and cutting 18 inches of it, all the way down, before commencing another "dess." The cost is very little: one woman cuts it as wanted, puts it into baskets, which are put on to a light waggon, carrying ten baskets of 30 lbs. each, pushed along the tramway to the farthest end of a long byre: feeding the cattle on either side as she goes along. I think our cattle eat the silage best after it is broken up and allowed to stand in the baskets several hours before being used. Two square feet have been cut out and put on one side for ten days, and is just as good as the day it was taken out. I believe it can be used gradually, as required, even for five or six months, without any deterioration. I have never seen any that has gone bad, *after* the silo has been opened.

We commenced to use the silage on the 19th; giving 14 lbs. per day to the stall-fed cattle, and reducing the turnips to 28 lbs. per day, all other food as before. Six milch cows were allowed 28 lbs. per day, the pulped turnips were taken off, but the bran and meal-croudies were given twice a day as before. In five days, nearly one-half the milk had gone off, the bowels became very costive, and the fæces dark coloured. No more cream or butter was obtained from the same quantity of milk than when the cattle were fed on the original food.

One-half the silage was now taken off, and 14 lbs. of pulped turnips substituted. In two days the milk returned to the usual quantity, and the bowels became less constipated. For fourteen days past, we have increased the silage to two-thirds, and only one-third pulped turnips, and all are doing satisfactorily, eating it with relish; the condition of the bowels is satisfactory, although the fæces are much stiffer than with ordinary feeding, but they are regular and darker in colour.

I am somewhat puzzled at the action of silage on the alimentary canal. At first I thought it must be owing to the quality of the fodder, and that the beans, peas, and tares, were the cause, and I am almost of that opinion still, only the lower half of the silage is *all* second-crop clover, and I can see no difference in the consistence of the fæces, when the cattle are fed off the top-half or the bottom-half, neither can we detect any difference in the secretion of milk, either in quantity or quality, when they are fed on one kind or the other; but so far as the experiments have gone, I believe the animals fed on the beans, peas, and tares silage, are in better condition. Still, without further experiments, and strict observation carefully noted, I would not like to give a decided opinion. One of my greatest drawbacks is not having "a weigh" to put the animals over whilst feeding under different conditions. The most satisfactory experiment is with eight in-calving heifers, six of which are loose in a large foldyard, and two tied up in the byre. All of these are within a few weeks of calving, and have had nothing but silage to eat since the 19th of December, except a bundle of oat or barley-straw each night in the "heck."

* Equal to 4*s.* 6*d.* per ton.—H. M. J.

They were fresh in condition when put on silage, having been tied up to turnips and meal for feeding, until discovered to be with calf in November, when they were taken out of the byre. They get about 30 lbs. each of the good silage per day, and part of the damaged from top and sides is also given them, a large proportion of which they eat at leisure. We cannot see any difference in their condition, and they look remarkably healthy and well, with silky coats and loose skins, and bright cheerful appearance. The two that are tied up, I think, are in the better condition of the two lots.

I was somewhat doubtful as to the wisdom of putting so many valuable in-calving heifers exclusively on silage diet when so forward with calf, fearing this new food might affect the calf-bed and bring about abortion; but being very anxious to test the real value of silage as feeding material, in as many ways as possible, I decided to risk the loss, and on the whole eight, as two or three would not have proved much. They have been watched closely every day, and, so far, all are doing exceedingly well.* We have also seventeen yearlings living entirely on silage since the opening, and all are thriving and looking fairly well.

I hope by the time the 70 tons are used, to be able to give a fairly safe opinion as to the difference in value of the silage made from leguminous plants and that made from clover-grass, as to their respective feeding-values. If silage is to be of any great value, as a feeding material, to the farmer, I think it must come by converting into silage our leguminous crops, instead of spending so much on our heavy soils in growing turnips, which in our northern climate is so expensive and so precarious. If we can do this to advantage, silage will be a most valuable adjunct to our other feeding-stuffs.†—*January 30th*, 1884.

I visited the silo on January 23rd, but have nothing to add except that the pitted fodder was very good, and that Mr. Hunting's well-known position as a veterinary surgeon gives his statements as to the effect of silage upon animals a special value.

28. *Mr. Garrett Taylor, Trowse House, Norwich.*—The silo is 14 feet long, 13 feet deep, and 6 feet wide, and is above ground, being constructed of 14-inch brick-work with a floor of 5-inch cement concrete in the end of a barn. Its cost was about 18*l.* 14*s.* 3*d.*, and it will last probably as long as we can look forward to. It was filled in July, and we purpose beginning again in June 1884.

The pitted material was sewaged Italian-rye grass, about $4\frac{1}{2}$ acres, and when cut to put in the silo was more than ripe. It was chopped into $\frac{3}{4}$ of an inch lengths by steam, Maynard's chaff-cutter being used. Salt was added only to preserve it.

The silo was filled in two days of 5 hours each, and every layer of about 6 inches was well rammed, 2 lbs. of salt being added to each. The fodder was covered with boards closely placed, and weighted with bags of sand; no mechanical contrivance was used.

The silo contains from 10 to 12 tons fit for use. The covering with old waste boards and sand cost about 2*l.*, and the expense of filling was 5*l.* 3*s.* 6*d.*

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* One of the heifers calved on the 3rd of February, and is doing well; the calf was well developed, and a plump vigorous little fellow.—C. H.

† Four of our horses are now eating the silage very well, five others only moderately, and three will not eat it. Neither the pigs nor the sheep care to eat it, either alone or mixed with other foods, but all the cattle seem to eat it with greater relish than they did, and leave all other food to eat it.—C. H., *Feb. 17th.*

The total is made up of the following items:—

	£	s.	d.
Mowing 4½ acres	1	11	6
Carting	1	11	6
Chopping	1	2	6
Pitting	0	9	0
Treading	0	9	0
Total	£5	3	6

Equal to 9*s.* or 10*s.* per ton.

When we wish to use the pitted fodder, we simply open a door in the centre, and use it as required for feeding.

By this system the land can be cleared much quicker, cheaper, and with less waste than by trying to make sewage-grass into hay. Indeed, for two or three years, we have found it impossible to get such Italian rye-grass dry enough to prevent it destroying itself by heat, on account of the juices and fat contained in the grass. With regard to keeping qualities, as this is the first silo we have filled, we can only say that we opened it on December 18th, 1883, and have continued using some of it every day since then up to this date, 11th January, 1884, and it is not injuriously affected by the atmosphere being let into it. Horses, cattle, and sheep eat the silage from the silo with great avidity, and I should think from the little experience I have had in feeding with silage it is best and most effective and valuable when mixed with straw, or corn-chaff, or any other ordinary food that requires something to increase its feeding value and make it palatable.—*January* 11*th*, 1884.

I visited this silo on December 18th, 1883, on account chiefly of the interest attaching to this attempt to preserve sewage-grass by means of ensilage. Evidently Mr. Taylor had been afraid to put the grass in too wet, and so had allowed it to get dead-ripe before pitting it. The consequence was that the silage was singularly dry for sewage-grass. It had, however, fermented, but there was a considerable amount of mould near the outside wall. A sample from the interior of the silo, sent to Hanover Square on January 2nd, although found to contain only 55 per cent. of water, is still, in the middle of March, perfectly good both in box and bottle, and retains to the full its honeydew aroma. The result of this experiment is very encouraging, and suggests a better future for sewage-farms.

29. *Col. Tomline (per Mr. H. Stevenson), Orwell Park Farm, Ipswich.*—The silo is 26 feet long by 12 feet broad and 12 feet high, namely, 6 feet below the level of the soil and 6 feet above. It is constructed entirely of concrete (walls about 14 inches in thickness), with slated roofs. I have made no experiments with regard to silos not covered by a durable or permanent roof. I cannot give the cost, but the structure will last about 50 years. Filling was commenced on July 30th, 1883, and was finished on August 4th, 1883, with green oats cut in an unripe state, and chopped into half-inch lengths. Nothing was mixed with the main crops.

The silo was filled at one operation as quickly as possible, in the following manner:—First fix the steam chaff-cutter at the filling end of the silo; reap the oats and cart them in their green state to the machine, and cut them ½ inch in length, throw them into the silo, and have 4 men inside to level and tread them down as tightly as possible, as the more solid they

are made the better they will keep. When finished, the planks and loaded boxes are arranged thus:—Cover over with planks, on which is placed 84 square boxes exactly fitting the silo, filled with bricks, shingle, &c., weighing 15 tons; no mechanical means are employed, and no record has been taken of the weight of the crop placed in the silo, nor has the silo yet been emptied.

The total expense of filling, covering, and compressing, was 19*l.* 6*s.* I cannot give the cost of emptying the silo, as the silage is used direct as required for daily use. The operation of removing the silage is simply performed by drawing it out with a four-pronged fork (*in small portions*) from the top to the bottom, as it will not keep if exposed to the air for any length of time. I have found that cows fed upon the silage have given an increased quantity of milk; that the cream was thicker, and the butter a richer colour and finer flavour. Last year I had two beasts feeding upon the silage, and commenced giving them 7 lbs. each per day mixed with 6 lbs. of cut clover-hay, and increased the silage to 3½ stones each per day mixed with 6 lbs. of cut clover-hay. By the end of April they were fat without cake or roots. The horses did well upon it, and the sheep also. The crops were considerably better when the silage was eaten upon the land by the sheep.

I have not found any result whatever specially attributable to succulence of the crops, or to external moisture upon them before being pitted. The silage can be consumed without deterioration if taken out by degrees extending over several months. My experience of silage proves that as a food, especially in conjunction with other feeding materials, it produces excellent results.—*January* 11*th*, 1884.

I visited this silo on December 19th, 1883. The facts are precisely as described above, but it should be added that Col. Tomline pursued the same system with the same crop last year, and was perfectly satisfied with the result. The oats are cut in ear, but while the grain is still milky, and the pressure, according to Mr. Stevenson's figures, is about 1 cwt. to the square foot. One fact that struck me very much was the more than usually powerful smell of the silage. It was apparently in the state of alcoholic fermentation, but it seemed to be more concentrated "grog" than any other silage that I had seen. I was informed that last year it had the same character, and that on exposure to the air it would not keep; but I am bound to add that a sample sent to me kept remarkably well in the Society's Laboratory.

30. *Mr. W. H. Wills, M.P., Coombe Lodge, Blagdon, Somerset.*—The silo is 13 feet by 12, and 13 feet deep; it is built on a steep slope, so that the forage can be tipped in at one end at the higher level, and the door approached at the other end on the lower level. It is built of local limestone set in brown lime mortar, the walls being 2 feet thick; and the floor is laid with rough paving made watertight. The covering is a Λ roof of pantiles without plastering. The building is a permanent one, and we worked out the cost of labour and materials to amount to 36*l.*

The silo was filled on July 3rd, 4th, and 5th with a second year's crop of clover after wheat, cut when ripe, and chopped to 1½-inch lengths. No salt or other material was mixed with it. The silo was filled as quickly as possible, each day's cutting being pitted the next day, and the crop trodden down firmly as put in by 3 or 4 labourers. This was my first experiment, so I followed as closely as possible the directions given in some

American agricultural reports. I covered the bulk of the pitted fodder with a thin layer of rough hay, over which 2-inch deal planks were laid closely together, but free of the walls, to allow of sinking. Above these were laid large rough stones, about equal to 3 cwts. per square foot. The field was $4\frac{1}{2}$ acres in extent, and was estimated to yield 35 cwts. of ordinary clover-hay per acre. Taking the pitted fodder to weigh, as is calculated in the United States, 50 lbs. per cubic foot, the contents of the silo amounted to $27\frac{1}{4}$ tons.

The cost of filling and covering the silo, as well as mowing the crop and hauling it from the field, was as follows:—

	£	*s.*	*d.*
4 men 3 days each, treading and filling = 12 days at 2*s.* 6*d.* ..	1	10	0
4 men 4 days each, covering = 16 days at 2*s.* 6*d.*	2	0	0
Hauling, horses and man, 3 days at 12*s.*	1	16	0
Cutting by steam, say	1	10	0
Mowing $4\frac{1}{2}$ acres at 5*s.*	1	2	6
Total	£7	18	6*

The door of the silo was bricked up inside with $4\frac{1}{2}$-inch brickwork; when this was pulled down we cut out the pitted material as from an ordinary haystack. The result was that instead of $7\frac{1}{2}$ tons of *inferior* hay (owing to very wet weather), we obtained $27\frac{1}{4}$ tons of excellent sweet and juicy "silage." As to the effect of moisture, I may say that one day was soakingly wet, and that the portion cut on that day, though still sweet, is certainly not equal to what was mown and chaffed in merely *showery* weather. Of the keeping properties of the pitted fodder, although my experience is not great, I should say that if the door is kept closed it will keep nearly as well as hay. Hitherto I have noticed no signs of unsoundness. We opened the silo on November 4th, just four months after it had been filled and closed. If needful the silo would have held 40 tons; and I am so satisfied with this, my first year's experience, that I am now building three more silos, and hope next year to make 100 tons of "silage."—*December* 10*th*, 1883.

A sample of this silage received on December 13th contained 65·2 per cent of water, and kept very well in a wide-mouth stoppered bottle.

31. *H. C. Fryer, Esq., Lodge Park, Glandovey, Cardiganshire.*—My silo is 20 feet long by 9 feet wide, and 9 feet deep, and is entirely above the level of the soil. It has been constructed as follows:—Having a barn, stone-built and slated, 20 feet wide, immediately adjoining my chaff-cutting loft, I partitioned off one end, 9 feet in width, by a stone wall. The whole of the interior walls were then covered with cement plaster, the floor being already of cement concrete; a strong deal door was provided at one end of the cross-wall, opening inwards, deal boards were screwed on flush with the outside of the wall, and the interstice between the door and boards was filled with sawdust. The cost of the cross-wall, cement, plaster, door, &c., was about 9*l.* The building will last a lifetime.

The silo was filled on October 4th and 5th, 1883, with Italian rye-grass previously cut for soiling, and mixed "seeds," from which a crop of seed hay had been made in July previous. When mown, the crops were not quite ripe for haymaking. All the materials were cut into chaff in lengths of about $\frac{3}{4}$ inch. I mixed about 2 lbs. of salt to each cwt. of silage. I fancied the salt would assist to preserve the fodder, and would also make it more wholesome.

* Equal to 5*s.* 10*d.* per ton.—H. M. J.

I think the quantity I used was excessive, and that 1 lb. per cwt. would be sufficient.

The silo was filled at one operation, as quickly as possible, on two consecutive days. But I had only green stuff enough to fill the pit to a depth of 7 feet 8 inches above the floor-level. The season was too far advanced to admit of more fodder being added after subsidence, as will be done next season.

The chaff was thrown into the silo direct from the chaff-cutter; it was there carefully spread, salt sprinkled over each layer, and the whole thoroughly well trodden and rammed, in order to consolidate the silage and exclude the air; the top was then roughly covered with shutters and boards; 10 cwt. of bran was spread over the top of these, about 4 inches deep, and a few boards placed across the top of this, in order to distribute the weight more evenly. The bran was used the more completely to exclude the air; but it is, I think, too costly for the purpose. The fodder was compressed by means of boxes (old wine-cases, &c.) filled with limestones; the weight of these stones was about 3½ tons, equal to a pressure of about 43 lbs. per square foot of surface. When opened at end of November, the silage had settled down from a depth of 7 feet 8 inches to 5 feet 3 inches, and was very compact and solid. The quantity was estimated at about 20 tons. The present weight of one cubic foot of silage taken 2 feet from the bottom of the silo is 52 lbs.*

The total expense of mowing, carting, chaffing, and filling the silo was as follows:—

	s.	*d.*	£	*s.*	*d.*
Mowing, 5 days at 3*s.*	15	0			
Loading grass, 4 days at 3*s.*	12	0			
Carting, 4 days (man) at 2*s.* 6*d.*; 2 days (boy) at 1*s.* 6*d.*	13	0			
Chaff-cutting, 2 days (man) at 3*s.*; 4 days (boy) at 1*s.* The chaff-cutter was driven by water power	10	0			
Throwing chaff into silo, 2 days (man) at 2*s.* 6*d.*	5	0			
Spreading chaff, ramming, &c., 2 days (man), 2*s.* 6*d.*; 4 days (woman), 1*s.*	9	0			
			3	4	0
If carting be added, 3 horses in 3 carts, 2 days each, 6 days at 5*s.*	..		1	10	0
Equal to, say, 4*s.* 9*d.* per ton			4	14	0

The boards for covering cost 30*s*; 10½ cwt. straw and carriage 4*l.*

The cost of emptying the silo is almost nil. We cut the silage down in sections from top to bottom, like hay in a stack. It comes off in compact layers, and is easily broken up for mixing with the dry chaff. The main result is a succulent food to take the place of roots altogether in early winter for mixing with chaff; and it does not, like roots, impart an unpleasant taste to milk and butter. It is much less expensive to grow than roots, and the process will enable the farmer in wet districts like Wales to save many a crop of seed and other hay grass, which would otherwise be spoiled by weather, and at much less cost than haymaking.

I have found no special result due to succulence of crops or external moisture upon them. I carried much of my grass in heavy rain; but this I think a mistake, as extraneous water is not needed; but the more succulent

* Giving a total weight of 22 tons of silage, if 52 lbs. may be taken as the average weight of a cubic foot.—H. M. J.

the fodder the more compactly can it be consolidated, and on this, I believe, depends mainly success or the contrary in preservation of silage.

The fodder preserved in my silo has been in course of very gradual consumption during more than three months; and it does not appear to suffer or deteriorate in the least by the exposure to the air (for several days at a time) of the sides from which the silage has been cut for feeding. I imagine that the keeping properties must depend mainly upon the degree of consolidation of the fodder. I find in my pit a layer of about 2 inches of inferior and more or less mouldy stuff on the top, also about 1 inch in breadth next all the side walls, varying from inferior to bad. All the rest is so compact that no air can enter the mass, and consequently it appears to keep as well as hay in a cut stack.

I have found the silage of great value as a succulent fodder for mixing with chaff of hay and straw as food for milch cows, especially early in the winter before mangolds are ripe. Having stored but a small quantity, I have used it almost entirely for cows in-milk; and with no other winter food have I ever found the butter so good in quality and in flavour.

I should add that the method of storing silage I adopted was founded on the recommendations of Mr. H. Woods, of Merton, to whom my acknowledgments for much good advice are due.—*March* 11, 1884.

Mr. Fryer was so good as to send me a sample of his silage for examination; but by the time it reached Hanover Square it had developed a very strong odour, and when the box was opened, the silage was found to be mouldy. This untoward circumstance may, however, have been caused by the manner in which the box was filled, which should have been done by cutting out one piece the exact size of the box, and carefully preventing the access of air to its interior.

Lord Tollemache's silos, which I visited on February 11th, 1884, have been frequently described in the agricultural newspapers, therefore a very brief notice of them will be sufficient here. They have been constructed out of existing buildings, and each one has been devoted to a separate experiment this year, chiefly with a view of ascertaining what is the influence of external moisture on the crop when pitted upon the quality of the resulting silage. The silo which was open at the time of my visit presented to view a vertical wall of well-consolidated meadow-grass. From 4 to 6 inches of material at the top was sodden, but there was little or no waste at the sides. All the pitted fodder had been mixed with 2 lbs. of salt per cwt., but Lord Tollemache and his agent are both convinced that this quantity is far too large. It makes the cows very thirsty, and for this reason it is found necessary to feed them with one-half silage and one-half chopped straw. The silage seemed to have been exceptionally well pressed, apparently because it had been put into the silos by single pitchforks-full, each of which had been immediately trodden hard by four men. The covering and weighting materials were the following:—(1) Doors consist-

ing of neatly fitting planks and cross-pieces; (2) bran, which, however, will not be used another year, as it has been found unnecessary; and (3) weights consisting partly of iron and partly of old gasoline boxes filled with gravel, the total weight being stated not to exceed about 70 lbs. per square foot. It should be added that Lord Tollemache has no home farm properly so called, as he only keeps in hand a few fields of grass to enable him to obtain milk, cream, and butter for his household. His silos are merely experiments, and he is so well satisfied with their success that he proposes to build them for his tenants if they will pay 5 per cent. on the outlay in the event of their being successful, but nothing at all if they should be unsuccessful. Lord Tollemache, it will be observed, regards his position and duties as a landlord very seriously.

Two samples of Peckforton silage had been sent to the Society's Laboratory for analysis previous to my visit. One sent on December 13th, 1883, contained 71·6 per cent. of water, and did not keep well; but the second, which was sent on December 27th, and contained 73·4 per cent. of water, kept better than the first, although it also went mouldy very soon.

With special reference to the cost of filling a silo, I may give a few further examples, as this is a point of primary importance. The Duke of Sutherland uses the ground floor of an old malt house as two silos, separated by a brick partition. Each silo is 19 feet 6 inches long, 9 feet 6 inches wide, and 12 feet deep. The total acreage of meadow-grass cut and pitted was 6 acres 1 rood 8 perches, and the silos were first filled on June 21st, 22nd, and 23rd, No. 1 taking in two days 23 tons 8 cwt. 2 qrs., and No. 2 in one day 19 tons 2 cwt. They were refilled on June 30th with 14 tons 19 cwt., and finally, on July 12th, with 13 tons 15 cwt. 2 qrs., making a total of 71 tons 5 cwt. The cost of the work was as follows:—

	£	*s.*	*d.*
Mowing 6 acres 1 rood 8 perches, at 9*s.* per acre ..	2	16	3
Filling silo, including filling bags of sand	6	18	4
Team work	4	4	0
Straw to cover silo, 4 cwts. at 4*s.*	0	16	0
Salt	0	1	0
Total	£14	15	7

Being rather less than 4*s.* 3*d.* per ton of silage.

The weighting material consists of 200 bags filled with sand, and weighing from 180 to 190 lbs. each; they cost 4*d.* each, making a total of 3*l.* 6*s.* 8*d.* in addition to the filling, which is charged for above. As, however, the bags may not last more than a year, the cost should be added to that of labour; this would make the total cost of the silage 5*s.* 1*d.* per ton.

A sample of the silage sent to me in the middle of February retained its excellent quality unimpaired during the month which elapsed before the completion of this Report, although in the meantime it had been kept entirely in the box in which it arrived; and Mr. Reid, the Farm-bailiff, informs me that the experiment has been a complete success.

On November 13th, 1883, I saw the opening of Mr. Robert Johnston's silos at Tyn-y-Park, Whitchurch, near Cardiff. These silos had been made by running a brick wall partition across a portion of a barn, and dividing the space into two equal compartments by another brick wall. The actual cost of this operation was 20*l.* 1*s.* 8*d.*, but the following account given me by Mr. Johnston shows what the silos would have cost if they had been built entirely *de novo*:—

	£	*s.*	*d.*
Size inside, 17 feet long			
" " 15 " wide			
" " 17 " high			
" in 14 inches brickwork			
Bricks 23,000, at 30*s.* per 1000	34	10	0
Lime and sand	2	15	0
2 doors and frames	1	15	0
Bottom cemented	3	10	0
Roof	12	15	0
Labour and building	11	17	0
3825 cubic feet	£67	2	0

To hold 70 tons.

Mr. Johnston is a large provision merchant in Cardiff, and keeps as accurate accounts of his farming operations as of his business transactions. Therefore it may be of interest to compare the following accounts of the cost of haymaking in 1881 and 1882, with the cost of making silage in 1883.

Cost of Harvesting 12 *Acres Grass.*	£	*s.*	*d.*
1881.—Mowing 12 acres, at 5*s.* 8*d.* per acre	3	8	0
Men and horses' time	16	0	0
Food and beer for men	5	0	6
Thatching	2	18	6
Spars	0	6	0
Total cost for 12 acres	£27	13	0
or per acre, 2*l.* 6*s.* 1*d.*			

	£	*s.*	*d.*
1882.—Mowing 12 acres, at 5*s.* 8*d.* per acre	3	8	0
Men and horses' time	13	19	2
Food and beer for men	4	15	0
Thatching	2	14	0
Spars	0	6	0
Total cost for 12 acres	£25	2	2
or per acre, 2*l.* 1*s.* 10*d.*			

Cost of Cutting 10 *Acres Grass for Ensilage.*

6 acres seeds.
$1\frac{1}{2}$ „ barley.
$2\frac{1}{2}$ „ oats.

10 acres.

	£	s.	d.
15 men,* 2 days, at 4s. per day	6	0	0
Food for 15 men, 2 days, at 1s. each per day	1	10	0
Beer	2	0	0
Sundry help	1	0	0
Horses and carts	2	0	0
Engine and man, 2 days, cutting	2	15	0
Salt, 3 qrs. at 30s. per ton	0	1	2
Bran, 3*l*.			
Total cost for 10 acres ..	£15	6	2
or per acre, 1*l*. 10*s*. 6*d*.			

It will be noticed that there is a difference of from 10*s*. 8*d*. to 15*s*. 7*d*. per acre in favour of the silage. Further it will be observed that the cost of providing the silo is again nearly 1*l*. per ton (actually 19*s*. 2*d*.) of its estimated capacity; and that the cost of making the silage, exclusive of the bran and the weighting material, is between 4*s*. and 5*s*. per ton. Old American butter firkins filled with sand were used for weighting, so their expense could not have been great.

.—Silos with Mechanical Means of Compression.

32. *Mr. C. G. Johnson, Oakwood, Croft, Darlington.*—The first silo consists of an old barn with a tiled roof. It is 15 feet long, 12 feet wide, and 8 feet deep, viz., 2 feet below the ground and 6 feet above, and is calculated to hold 28 tons. A newly built silo is 18 feet long, 10 feet wide, and 22 feet high, is calculated to hold 80 tons, and will be filled with second-crop clover. The following details refer to the old silo, which was first filled at the end of June 1883 with old meadow-grass; but the material was taken out again soon afterwards in order to enable improvements to be made in the pressing mechanism, and was then made into hay. It appeared well cured, and was very satisfactory. The silo was re-filled on August 14th, August 22nd, and finally on August 28th, the grass being cut in the same condition as it would have been if haymaking had been the object. It was pitted whole, and mixed with about 20 lbs. of salt per ton. The pressure applied is calculated to be 200 lbs. to the square foot, by means of a weighted lever acted upon by a hydraulic ram, after the removal of which the pressure is continuous. I prefer this mechanical arrangement to dead weight, because of the time lost at each end of the filling days in taking off and putting on the dead weights. I thus get the whole day for filling instead of only a few hours in the middle of the day.

The covering over and compressing by mechanical means only occupies a

* 4 Mowers; 2 pitchers; 2 carters; 3 filling on stages; 2 keeping engines clear; 2 feeding, cutting. Total, 15 men.

couple of men while the others are putting the tools away. The fodder will be cut with a hay-knife or spade vertically, and removed by a barrow or cart, to admit either of which there is a door sufficiently wide.

As regards the succulence of the grass or its moist condition, I have never yet filled a silo during any appreciable amount of rain, but from what little experience I have gained, I may say that I should like to have no rain-water, and the crops just ripe enough to make good hay; and another year I shall be very particular to secure that climax. I have had no experience as to the keeping qualities of the fodder after it has been opened, but the arrangement of the mechanical pressure is carefully designed so as to require the removal of the pressure only from the part which is to be cut and removed.

Hitherto I have had no experience with regard to the use of pitted fodder for stock,* but during the winter I mean to try, both with the old grass and the second crop seeds and clover preserved in the two silos, as substitutes for turnips in fattening bullocks for the butcher. I shall probably give them the pitted fodder with linseed and cotton-cake, and possibly a further mixture of maize and bean-meal, which is my habitual mixture of stimulants. Anyhow, they shall have the same variety of such foods as a similar number of the same class of animals fed on turnips, thus making the experiment one of pitted fodder *versus* turnips.—*August 25th*, 1883.

Mr. Johnson has since given me the following description of a new silo, with illustrations of the mechanical arrangement by which it is weighted :—

The building is of brick, all above ground, with slated roof. It is 28 feet high up to the eaves, 10 feet by 18 feet inside, 9-inch walls, with the exception of the front end, around doorway, which is 14-inch work; and is designed to be filled to 22 feet high of silage, leaving the remainder for working room.

I began to build about the 1st of September, and the fodder intended to be saved (second-crop seeds and clover) must be all in before, say, the second week in October, consequently there was no time for the lime to dry; and, being ignorant also as to the amount of lateral pressure to be expected from within, I thought it safer to have the walls up to 22 feet from the ground set in cement. Experience proved there was no lateral pressure observable. My next silo will therefore be either sheet iron, wood, or 9-inch brickwork set in lime.

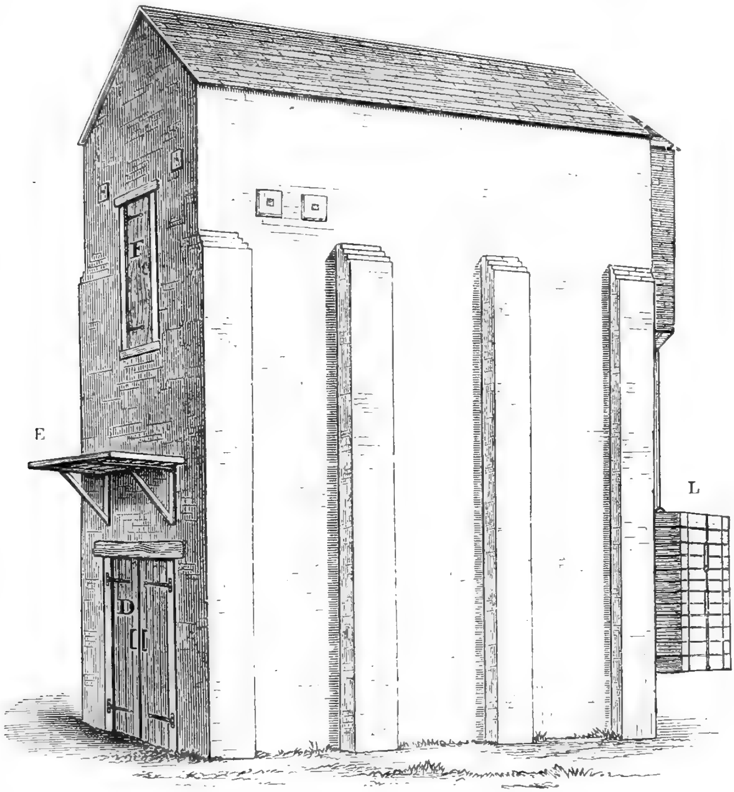
The bottom of the silo consists of a framework of rough wood (A, Fig. 4), upon which the silage rests, and which, taken hold of by two rods communicating with one end of the lever-beam (C), enables the weight of the silage to be used as the fulcrum from which to inflict the pressure upon itself—thereby saving the necessity of heavy masonry, which would otherwise have to be provided to keep down the short end of the lever.

The crop is at first thrown in through the large folding-doors (D) at the bottom, which are made wide enough to admit a cart to back into the silo to remove the silage. As the grass rises, this space is made up by loose boards (in my case old railway sleepers), one on the other edgeways. When it has risen above this aperture it is forked off the cart by one man on to a scaffold (E), and thence by one man standing thereon through the long-shaped window (F), which, as the grass rises, is also made up with loose boards as before described

* Since sending the replies to my questions, Mr. Johnson informed me, in a letter dated Dec. 3rd, that he had used the contents of the old silo in feeding sixteen head of stock, giving them only their artificial food in addition, and that one small heifer which had had five weeks finishing upon it he had sold by auction for 23*l.*—probably the first ensilage-fed beast killed in the north of England. She had fattened very quickly.—H. M. J.

—the latter being in this case to save unnecessary forking until the stack has risen. I may here mention that, though I did not fill up the interstices between the boards (which I could easily have done), the silage was just as free from mould as at any other part of the wall sides; and further, it may be mentioned that when the pressure was first applied from above, the air could be heard hissing out through these spaces.

Fig. 3.—*External View of Mr. Johnson's new Silo.*



When the day's filling is complete, the top covering of boards (G, Fig. 4) is laid on with longitudinal and transverse timbers (H) to receive the pressure; the hydraulic jack (I), which it may be seen is at the weighted end of the lever, then comes into play, and lowers the wrought-iron cradle and transverse timbers, which are attached by chains to the lever beam on to the longitudinal timbers; and a strong round iron bolt (K) is then adjusted into one of the holes in the cradle according to the height of the silage. The whole force of the weight of the boxes full of stones at the out end of the lever, which is about four and a half tons multiplied by the length of the lever, then comes on and inflicts a pressure of about 2 cwt. per square foot (including the weight of the beam, cradle, boards, and everything); this at once presses down the grass about 2 feet, which is the extent of travel the lever gives at the point of

pressure. The hydraulic jack is then worked by one man or very easily by two, and, having a stroke of about 6 feet, quickly raises the weighted lever; the pin in the cradle is withdrawn, and put in so many holes higher (see

Fig. 4.—*Section of Mr. Johnson's new Silo.*

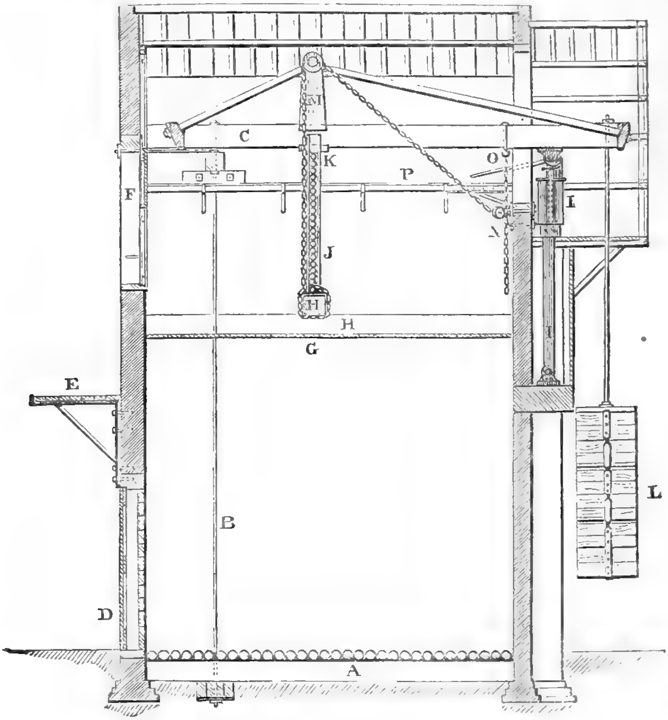


Fig. 5.—*Plan of Mr. Johnson's new Silo, showing Beams for pressure, Covering-boards, &c.*

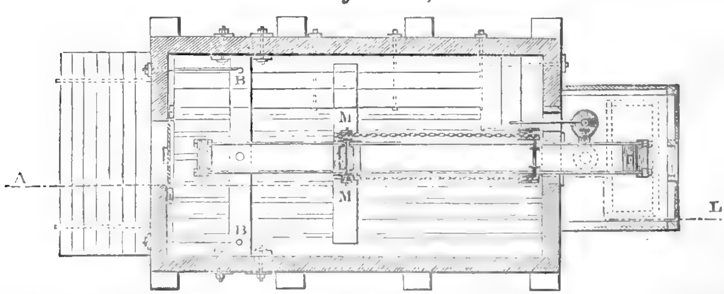


Fig. 6), say 2 feet. On comes the pressure again; and this time, the grass having become so far solidified as to be able to bear the weight, the beam is kept up at, say, half stroke, and there hangs the weighted lever, preserving

a continuous pressure of about 16 tons resting upon the grass. Or if the attendant is not satisfied, and has reason to fear that there is not sufficient travel left to allow for the sinking of the grass before he comes again next morning, he raises it again to full stroke, and it is found that this is ample to last well into the next day, and thus secure continuous pressure. Next morning we generally found the silage sunk about another foot; the lever is raised by one man in a few minutes, and the weight left hanging in such a position that it must sink about 2 feet before it need again be adjusted. This is not generally for some days; and shortly, as it becomes settled, need not be looked to for weeks.

It will be seen by the section of the silo (Fig. 4), that the cradle upon which the beam rests its pressure does not appear long enough to reach the grass when only a small first day's work may have been put in. This, however, is provided for, as, though not easily shown on so small a scale, it is made telescopic (Fig. 6), and lengthens out to follow the silage. It will also be

Fig. 6.—*Details of Pressing Apparatus.*

observed that the chains which are attached to the cradle and transverse timbers are carried over two pulleys (M) at the top of the beam, and thence, after passing through two snatch blocks (N) fastened to the wall, can be hooked on to the lever beam (O), and then, by working the jack through its full travel of 6 feet, they are raised about 8 feet out of the way of the people treading the grass.

When it is desired to remove the silage for consumption, the hydraulic jack raises the cradle, boards are taken off as far as required, and the weight put on again—the cradle retiring towards the outer end of the lever as each section is cut. Thus the same uniform continuous pressure is maintained, the weight on the cradle being reduced by the shortening of the leverage in proportion as the area to be pressed is diminished.

Near the top of the silo there is a shelf (P) which is for the piling away of the covering boards, and for the man to stand on to work the jack.

I believe my silo, when full, holds 90 to 100 tons; the weight of a cubic foot of silage 6 feet from the bottom was 60 lbs.

Of course, the somewhat unusual height of the building is to save first cost, as the expense of pressure is the same for a high silo as a low one. Also, the deeper the silage, the more pressure from its own weight, and the more full days' work at filling, not so much time being lost in starting and stopping as is the case with the small fillings for so many toppings out. This, to my mind, more than compensates for the wages of the man who forks off the scaffold, or for an elevator, if the latter be preferred.

I prefer silos above ground, because it saves excavating; and, after all, you cannot have less than 9-inch work, and in most cases the earth would require more to keep it up. Again, it is much cheaper to fork off a cart in the long days of summer than out of a deep hole every time you fodder the cattle in winter, as will be found when this new feed gets into the wholesale scale of every-day practice. Besides, there is the risk of water oozing through your cemented walls and making tea-leaves of the silage.

I may add that for the last two months I have been feeding sixteen bullocks and heifers of the largest size on nothing but silage and 6 lbs. daily of cake and meal; and the result is, I consider, at least a dead heat between them and similar bullocks on the same allowance of cake and meal, and turnips and hay *ad lib.*, instead of silage.

At present I do not believe in light pressure or no pressure. The weight of evidence goes to prove that the greater the pressure the better the silage—the limit being that point at which the juices begin to squeeze out. Up to that point, weight pays in the quality of the product, and in the quantity stored in a given space.

The major part of my silage was made with 20 lbs. of salt per ton of grass, but I put some 10 or 12 tons on the top without any salt. Another year I think I shall use no salt: I consider the silage better without, and above all I found the cattle very thirsty from that with salt, and not at all so whilst on that without salt. As to the cost of getting and filling, the following is a whole day's work. It took ten different fillings to put in about 80 tons, of course many of them being less than half days, and with only two or three horses, and proportionally few men; and if I had had any more grass to put in, and having allowed the silage to settle, I could have got about three more fillings of, say, 10 tons, 5 tons, and 2½ tons each. The mechanical system of pressure has a great advantage in allowing a silo to be filled up as long as any space remains, without the labour necessary to remove the dead-weight each time, which with that system scarcely seems worth while for small quantities.

Cost of putting in silo a quantity of second-crop seeds and clover, led one and a quarter miles, 25 tons put in from about 8 A.M. to 5 P.M.

	£	s.	d.
Man and pair of horses mowing and raking	0	14	0
5 single-horse carts and drivers	2	0	0
2 men forking in field	0	6	0
1 man forking off stage into silo	0	3	6
1 old man and a woman spreading in silo	0	2	6
Beer	0	4	0
	£3	10	0

2*s.* 9½*d.* per ton.

The total cost of this silo has been about 150*l.*, but doubtless it would have been more had it not been a home-made structure.—*January* 18, 1884.

I first visited Mr. Johnson on August 20th, 1883, when only the old barn-silo was in operation. The pressure was applied as follows:—First the pitted fodder had been covered with old sleepers laid from side to side of the building, then two round lengths of fir or larch were laid across them (*i.e.* from one end of the building to the other), and upon these was brought to bear a leverage, like the old-fashioned cheese-press arrangement—the beam of the lever having at its end a big case filled with stones. By adding more stones, or taking some out, the pressure could easily be increased or diminished. A hydraulic jack was used to release the silage from pressure, at such times, for instance, as when it was required to raise or lower the fulcrum, which consisted in adding to or taking from a pile resting and acting transversely across the fir or larch logs.

On January 22nd, 1884, I paid my second visit to Mr. Johnson. In the meantime the old silo had been opened and a new one built. The means of mechanical pressure had been much improved, but at a considerable cost, namely, 40*l.*, although Mr. Johnson, having been educated as an engineer, drew out his own plans, bought the materials himself, and supervised the

construction and arrangement of the whole. Under other circumstances the cost of the apparatus would have been much increased, some people say almost doubled. Mr. Johnson has been so good as to furnish me with tracings, from which the preceding illustrations have been taken.

The total cost of building the new silo, calculated to hold 80 tons, with brick and an internal layer of cement, as well as a slated roof, but only a round-log, or "corduroy," floor, including the weighting apparatus, Mr. Johnson has himself given as 150*l.* The fodder was all pitted long, and its quality was generally excellent, but some layers were not so good as others. In fact, the quality of the silage varied with that of the original material, most of which had been bought. Notwithstanding the heavy pressure—200 lbs. to the square foot—very little juice had been expressed.

33. *Mr. S. H. Stocks, Cleckheaton, near Normanton.*—My wooden portable silos are specially designed and adapted as tenants' fixtures, and are intended to be placed in any existing barn or shed. They can be constructed of any size, but one capable of holding 25 or 30 tons is the size recommended.

It has for some time been felt that the method heretofore adopted for pressing the contents of the silo, viz., the use of blocks of stone or other heavy weights, which had to be lifted or craned off and on, was cumbrous, and involved far too great an expenditure of time and labour; and various methods have accordingly been tried with the view of effecting a saving in these respects, but the great difficulty has been the want of an evenly distributed and continuous pressure.

A careful consideration of this difficulty has, after many experiments, led to the invention of the patent press. By this simple and effective contrivance (the chief features of which are the screw and spiral springs)—see drawings—a continuous pressure equal to 150 lbs. to the square foot (or more, if necessary) can be evenly distributed over the whole surface of the silo.

When the silo has been filled to the top, the press can be applied and the contents reduced at once, at the same time forcing out the air, which is the most important element in producing good silage, and the process of filling can be proceeded with immediately. This press can easily be applied to existing silos.

In farms of large extent, portable carbonated iron silos are recommended, as they can be placed on any part of the farm contiguous to where the stock is kept, and if found desirable, they can be partly sunk in the ground; a light roof can be erected over them at a trifling cost.

The advantages claimed for these silos over existing ones are:—

1st.—They are constructed at much less cost.

2nd.—They are portable, and can easily be taken to pieces and removed, if it is found expedient to do so.

3rd.—The contents of the silo can be pressed more effectively, there being continual and even pressure.

4th.—No ramming is required when filling, thereby saving labour and preventing the forage from being bruised.

5th.—The covers, or any part of them, are easily and readily removed and replaced when using or filling, so that no portion of the silage need be exposed except what is being cut away.

On January 26th, Mr. Stocks wrote to me as follows:—

"As promised during my conversation with you at Darlington last Tuesday, I have to-day forwarded a sample of the aftergrass silage made in the wooden silo I named to you.

"This grass was cut about the 20th of October last during rain, and the greater part of it was laid in the field for eight days after being cut, the weather being very bad at the time; in fact we had almost incessant rain until the 31st, when the last load was carted to the silo.

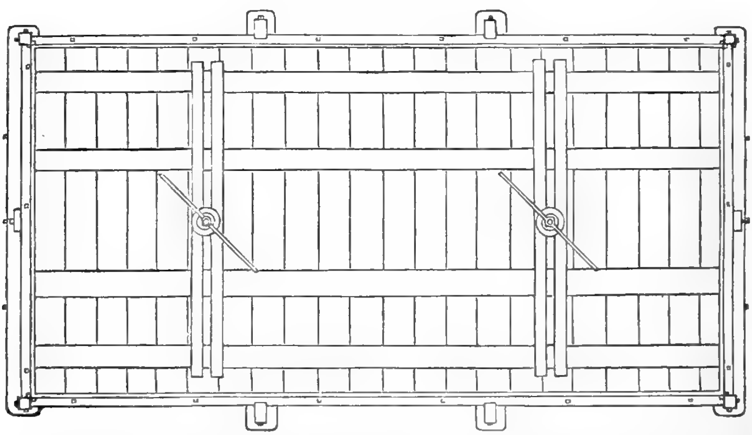
"Everybody predicted that it would prove nothing but a dung-heap, it was so bad, the grass being quite yellow from exposure, and soaking wet when put into the silo. Yet the cattle eat it with relish, and there is no diminution in the quantity or quality of the milk after a fortnight's feeding from it.

"I am sending you also by Parcels Post a sample of butter churned last week. This butter is the produce of cattle fed from this silage during the last fortnight; and for eleven weeks previous, from the silage produced in my concrete silo, which was put in last July and opened on the 20th of October, a sample of which I am also sending you; and although it is not quite so good as it has been (being now nearly finished), you will, I think, admit that it is good silage. The only food that has been given to my cattle has been 50 lbs. of silage, 4 lbs. of Indian meal, and 2 lbs. of bran, each cow per day.

"I am agreeably surprised to find that there is not the slightest mould to be seen in my wooden silo, and we have now got well into the second cutting, or section, so that I may safely assume that if there had been mould, it would have been seen ere this.

"I send herewith drawings of a wooden silo similar to mine, showing the press, springs, &c. The cost of a wooden silo this size, 20 feet by 10 feet,

Fig. 7.—*Cover of Wooden Silo, showing the means of distributing the Pressure.*



by 10 feet deep, with press complete, is 50*l.*, and its capacity 40 tons. It is coated with a solution of carbon inside and out, to preserve the wood from the decaying action of the juices of the grass. I may also state that the press and springs can be applied to any silo of the same size at a cost of 18*l.*, and the springs, when closed, show a pressure of 150 lbs. to the square foot

(which I am satisfied from experience is sufficient pressure to produce good silage); but if more is required, it can be applied by screwing down still further, as the rods are capable of a strain of over 20 tons each.

Fig. 8.—*End Section of Wooden Silo, showing Press Rods, Springs, &c., and how applied to the Cover.*

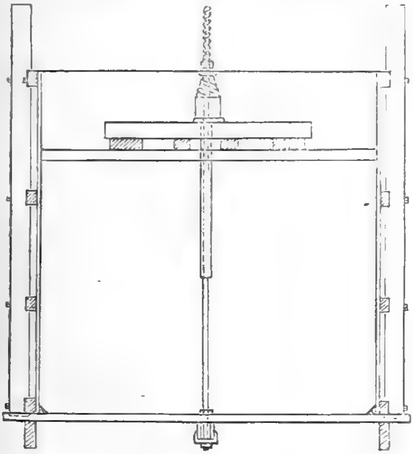


Fig. 9.—*End Section of a Concrete or Stone-built Silo, with Screw Press in operation.*

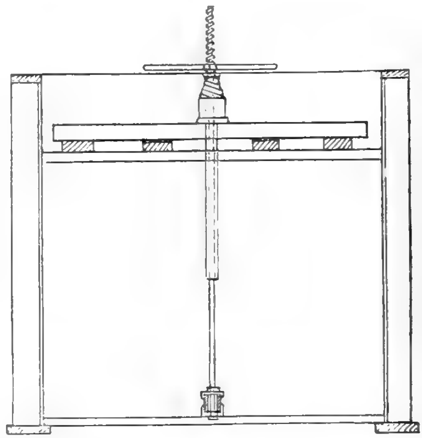
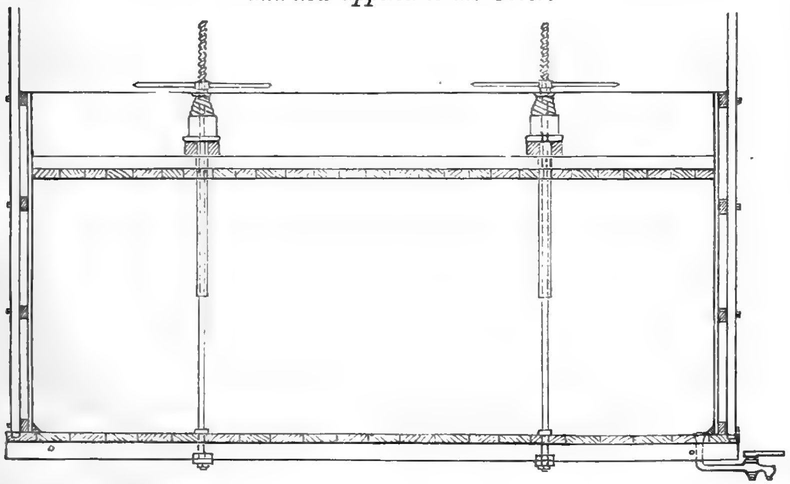


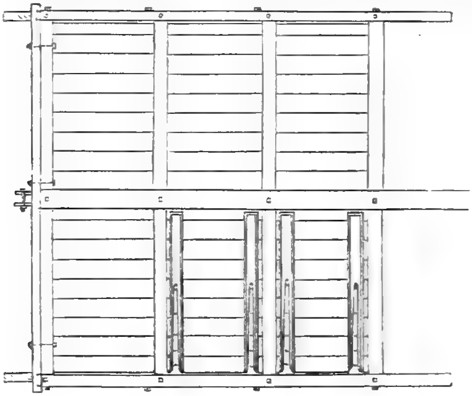
Fig. 10.—*Side Section of Wooden Silo, showing Press Rods, Springs, &c., and how applied to the Cover.*



"Now the cost of pig-iron to weight a similar surface would be at least double that amount, without taking into consideration the saving of time and labour in applying the screw-press, as compared with the lifting on and off of the dead-weights.

"My press can be applied in 15 or 20 minutes, whereas it is obvious that the putting on of dead-weight must occupy a very considerable time, but there is a further advantage of great moment. In filling a silo, after say 4 or 5 feet of grass has been put in, the press can be applied, the air expelled, and the contents reduced at once, which enables the filling process to be immediately proceeded with, without waiting for the gradual settling of the fodder.

Fig. 11.—*End Elevation of Wooden Silo, showing Doors.*



"Since my interview with you I have thought over the matter of the action of the sun upon a wooden silo, which might have caused the joints to open, and the remedy I shall adopt is this:—Instead of having 1¼-inch boards to line the silo, I shall adopt a double lining, one of 1-inch floor-boards, and the other of ½-inch ditto, with joints crossing or overlapping each other, and waterproof paper inserted between.

"I may say that I supplied to a gentleman near here, a silo 15 feet long and 10 feet wide and 10 feet deep, with roof attached, and it stands in his rickyard along with other stacks, and although not yet opened, there is no fear of the result."—*January 28th*, 1884.

On March 4th Mr. Stocks further wrote as follows:—

"In August last I erected my first wood silo (6 feet × 6 feet × feet), and on the 22nd of that month it was filled with 3 tons 9 cwt. 2 qrs. of oats and clover, cut quite green, to which I added as an experiment 10 per cent. of bran (780 lbs.) and 140 lbs. of salt, which were thoroughly mixed with the chaffed fodder, my object being that the bran should absorb the juices of the fodder, which it has done thoroughly.

"The silo was filled to the brim, the cover put on, and the screw-press applied, which reduced the bulk some 8 or 9 inches at once, and since then it has only settled 4 inches further. The lever has only required to be applied twice since the first application, and that within the first week, and the time occupied on each occasion was not quite 10 minutes.

"On Friday last the silo was opened, and there is not the slightest mould or waste, the silage being quite good up to the covering boards, and the flavour beautiful,—the best I have seen yet. I sent you sample of it by Parcels Post last night, and shall be glad to have your opinion of it."

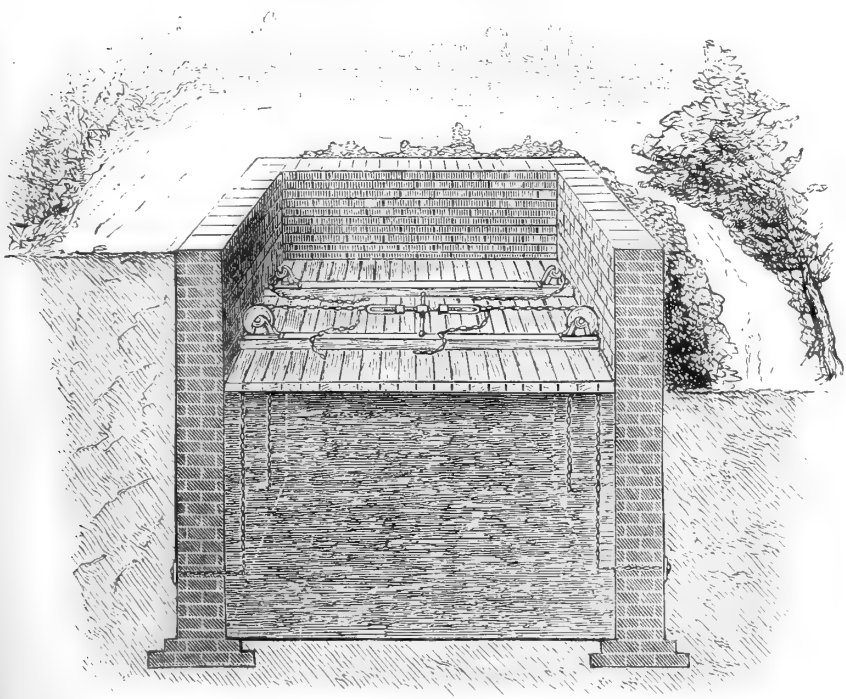
Not having seen any of these silos, but only the samples sent

me by Mr. Stocks, I can only say that the quality of the silage was very good, slightly acid, and has kept perfectly well.

34. Messrs. *F. W. Reynolds & Co., Edward Street, Blackfriars Road, London, S.E.*—This firm has patented another arrangement for the mechanical compression of fodder in silos, which is thus described by themselves.

These patent appliances consist of chains, rollers, and screw-apparatus for tightening the chains. A chain is attached to the lower part of the wall of the silo, in any suitable manner, either by taking it through the wall with a plate and bolt on the outside, by weighting it in the ground with concrete, or attaching it to a beam. Exactly opposite, on the other side of the silo, is a similar chain attached in the same manner. While the silo is being filled, the ends of these chains are thrown over the walls or hung on spikes on the sides. After the material is put in the pit, covering-boards are placed over it, and a stout transverse beam is laid on the top, stretching from side to side of the silo. In the ends of this beam brackets are fixed to carry movable rollers, over which the ends of the chains from either side are led. The hooks of the chain-tightener hook into the links; and on turning the handle of the screw, the ends of the chain are drawn closer together, causing the beam and covering of the silo to sink, and so to press the material. Pins are then

Fig. 12.—*View illustrating Messrs. Reynolds's Patent Appliances for compressing Fodder in Silos.*



inserted in the links of each chain to hold the beam down, when the screw-tightener can be made to take a fresh hold on the chain for further pressure, or be removed altogether. Any number of beams may be used, according to the length of the pit and the pressure required per square foot of surface, but the chain-tightener and pair of rollers are removed from beam to beam, so that only one set of these is sufficient for any number of silos. What are really required for each beam, are the two chains and two brackets or bearings into which the chain rollers are placed when in use.

If, for example, a silo of 15 feet long by 12 feet wide is to be pressed with a pressure of 200 lbs. per square foot of surface, two beams would be required, each having its two chains. In tightening the chains, a pressure of 8 tons can be put upon each beam, or 16 tons on both, and this force, divided by the area of 15 feet × 12 feet, equals 200 lbs. per square foot of surface. The silo may be any reasonable depth, an extra length of chain being all that is wanted. Should a greater or less surface-pressure be required, it is only necessary to place the beams nearer together or further apart. So easy and powerful is the action of the chain-tightener, that it is found that one man, by exerting a power of about 60 lbs. (theoretically 40 lbs.), can put a pressure of 8 tons on the beam; therefore one man only should use the screw, or unnecessary pressure may be obtained. By exerting the pressure once daily for about a week, it is then found that the silage cannot be compressed further, except at considerable intervals: the application of a continuous dead-weight is therefore found to be unnecessary. By these patent appliances the pressure can also be instantly released, and the boards removed to complete the filling of the silo, or when the silage is to be cut; the pressure can also be applied at any depth of the silo, either from the extreme top or at any distance from the bottom. The covering-boards for the silo may be 2 inches thick, and the transverse beam for a silo of 12 feet wide should be about 9 inches wide by 7 inches deep.

The following are the prices of the appliances:—

	£	s.	d.
Two wrought tested chains (special brand and pattern), at per foot, depending on depth of silo	0	1	0
Two sets of cast-iron brackets for chain-rollers, with eight coach-screws for screwing to ends of beams ..	0	16	0
Two washer-plates, with pins for holding down	0	4	0
(*The above being required for each beam.*)			
4-ton screw chain stretcher, with hooks	£4	0	0
Two cast-iron chain-rollers	1	0	0
(*Sufficient for any number of silos.*)			
EXAMPLE.—A silo 60 feet long, by 12 feet deep, by 12 feet wide, to produce a pressure of 200 lbs. on the square foot, would require 8 beams, carrying 16 chains each of 20 feet = 320 feet at 1*s*.	£16	0	0
16 sets of cast-iron brackets for chain-rollers, with coach-screws for screwing to ends of beams, at 8*s*. per set	6	8	0
16 washer-plates, with pins for holding down, at 2*s*.	1	12	0
	£24	0	0
One 4-ton screw-chain and stretcher, with hooks	4	0	0
Two cast-iron chain-rollers, at 10*s*.	1	0	0
	£29	0	0

As I have seen only a model of this machine, I cannot say anything as to its capabilities, but the patentees inform me that they have a silo on view at their works fitted completely with their appliances.

Before leaving this part of the subject I should mention that "portable silos" are made by Messrs. W. H. Lascelles & Co., of 121, Bunhill Row, London. They have been described and illustrated in 'The Field,' and can be seen at the Company's works in London, therefore I need not dwell upon them in this Report.

IV.—Foreign Silos.

A. France.

1. *Vicomte Arthur de Chezelles, Domaine du Boulleaume, près Chaumont-en-Vexin (Oise).*—The silo is 62 mètres (206 feet) long, 4½ mètres (15 feet) high, and 6½ mètres (21½ feet) broad, which allows vehicles to move about in it with facility. It is entirely below the level of the soil, and is constructed of masonry covered with a coating of cement. The walls are 85 centimètres (about 2¾ feet) thick at the bottom, and 55 centimètres (about 1½ feet) at the top. I commenced by an uncovered silo, and succeeded very well by covering the same with a mass of straw. But I soon recognised the necessity of sheltering this same straw under a roof, and by this means to make a large shed where I could place my wheat and oats instead of stacking them. The silo cost 4000 francs (160*l.*), the covering 6000 fr. (240*l.*); total, 10,000 fr. (400*l.*) Thus made it should last for an indefinite time.* It was filled this year (1883) towards the 25th of May, and the filling was finished with the second crop towards the 15th of August, and with maize towards the 15th of September.

I preserve crops of all kinds in the silo, such as red clover, *Trifolium incarnatum*, sainfoin, lucerne, and meadow-grass, winter and summer vetches, maize, &c. According to my experience, all crops should be mown and pitted a few days before ripeness, and when they are full of sap. They are pitted in a chopped state, the average length of the cuttings being from 4 to 8 centimètres (about 1½ in. to 2¾ in.). No dry substance is ever mixed with the green food at the time of pitting. About 3 to 4 kilogrammes (about 6½ to 8½ lbs.) of salt are sprinkled on a surface of 8 mètres (26 feet). The silo is filled in sections of 8 mètres (26 feet) length as quickly as possible. The crops are trodden as they are put in, more especially along the side of the walls. The pitting of the crops is hurried, so as to avoid introducing air into the mass, and to arrive slowly at a lactic fermentation, to be followed by the alcoholic stage, and then to arrest it there so as to avoid the acetic fermentation. The material is compressed by the treading of the men employed in levelling the pitted fodder, and also by the stamping of the oxen and horses, which I make pass over the silo in going and returning from work. The produce, per hectare (2½ acres), when placed in the silo is about 24,000 kilogrammes (24 tons). Once pressed, this produce occupies 23 cubic mètres, weighing about 800 kilos. (16 cwt.) the mètre.† It has been proved

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* I am indebted to the courtesy of the editor of 'The Field,' for allowing me to reproduce the illustrations of M. de Chezelles's silo given on p. 208.

† Taking the cubic mètre to be 36 cubic feet, this would give a weight of about 50 lbs. per cubic foot.—H. M. J.

Fig. 13.—*Sectional view of M. de Chezelles's "Grange Silo."*

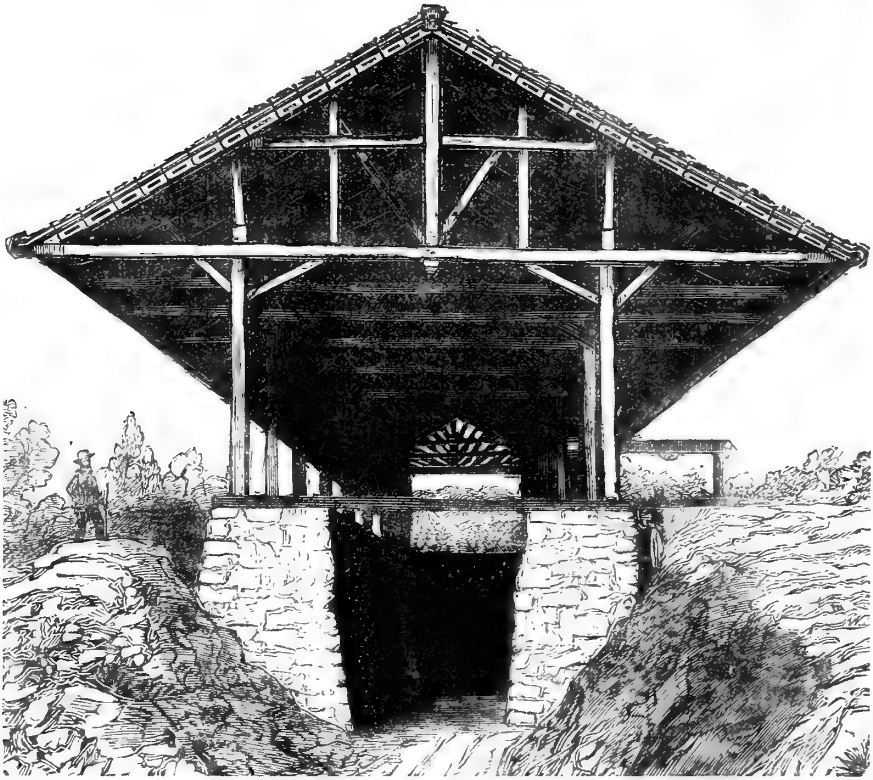
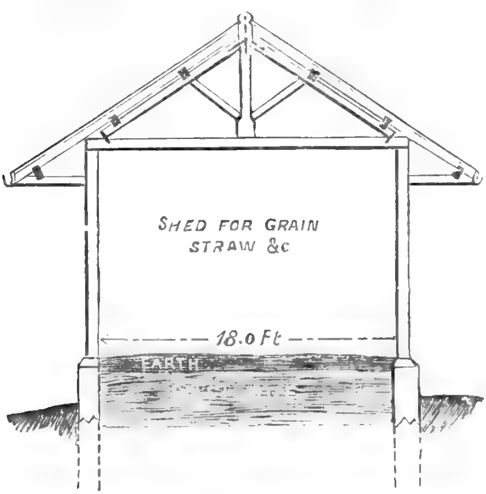


Fig. 14.—*Transverse Section of M. de Chezelles's "Grange Silo."*



that whole fodder diminishes nearly a half; when chopped, the reduction is only a quarter. For fodder chopped by an engine, the cost for manual labour alone is 20 francs per hectare (6*s.* 4*d.* per acre); for whole fodder the net cost is 7 francs per hectare (2*s.* 3*d.* per acre). In both cases mowing and cartage must be added to the above cost.

The fodder is cut down vertically 1 or 2 mètres in breadth, according to the needs of the farm, and is done similarly to the method employed for hay in a stack. Firstly, a great saving of manual labour has been effected in avoiding the haymaking, and thus making oneself independent of inclement weather, and being able to gather in the crops even on a rainy day. It has been recognised that this fermentation renders the fodder thus preserved more assimilable than it would otherwise be. It has been proved that when giving the cattle, on the one hand, pitted fodder, and, on the other, that dried according to the ordinary method, they have all preferred the former. Never has a case of indigestion caused by this food been known; and it is even thought that it excites the animals' appetites. This fodder can be preserved easily from one year to another, and some has been kept two years without deterioration. The fodder, although separated from the mass, can be consumed 6 or 8 days after, without being spoilt. Silage is spoilt from two causes: (1) the fault of pitting, by which air is introduced into the mass of the fodder; (2) holes, allowing water to get into the silo. For the feeding of the cattle on the farm of Bois Guillaume au Boulleaume, the chopped fodder from the silo is brought to the farm and mixed with thin straw, chopped straw and mangolds for the cows, and with beetroot pulp for the oxen. It is the same for sheep and other animals for fattening. As a general rule, there should be one-third dry food in the mash of the adult animals. In my mashes about 20 kilos (45 lbs.) of pitted fodder are placed per head of full-grown cattle.—*September 22nd.*

P.S.—The following are the details of the rations of the several kinds of stock as given during the winter 1883–84:—

1st. For Cows:—22 lbs. of pitted fodder mixed with other foods, making a total of 132 lbs.

2nd. For Heifers who remain at grass all the winter:—About 33 lbs. of pitted fodder mixed with oat-straw.

3rd. For Horses:—13 lbs. of pitted fodder mixed with other foods.

4th. For feeding-beasts (Oxen and Cows):—26 lbs. of pitted fodder mixed with other foods.

5th. For Sheep:—about 2 lbs. of pitted fodder added to the remainder of their food.

In reply to a special question as to the influence of silage on the breeding powers of cattle and sheep, M. de Chezelles's "regisseur" replied as follows:—

Since our cattle have been fed on pitted fodder, we have experienced none of the evils of which you speak. Each year I breed heifers which get on very well; in fact I have never had a single mishap. All our cows are in excellent condition. Gestation is quite normal and abortion very rare. I am happy to furnish you with these details, as they are the exact truth. I have proved it also with my sheep, which are all going on extremely well. This would not, however, have been the case if these beasts had been fed exclusively on beetroot pulp. M. le Vicomte de Chezelles has tried it, but the result has not been successful. Up to the present, the pitted fodder has yielded very satisfactory results, though, as you are aware, it is never given by itself to the cattle.

The Vicomte de Chezelles has issued the following directions for pitting green fodder:—

I think that the crops should be cut a few days before maturity, and when they are full of sap. All kinds can be pitted, viz., *Trifolium incarnatum*, lucerne, sainfoin, meadow-grass, winter and summer vetches, rye, and green maize, though the latter is less profitable pitted than when eaten green (this refers to my district). The pressure should be arranged as regularly and evenly as possible, especially along the wall and in the corners of the silo. Pressure is obtained in the middle by making the cattle and horses pass over it when going to and returning from work. It is absolutely necessary to have a man in the silo to spread the fodder as it arrives. It is difficult to give the pressure per square mètre. No straw or well-dried hay must ever be mixed with the green crops that it is intended to pit. The walls of the silo should be plastered over, but the bottom should be made of a good dry ground. The former should be straight, and the corners rounded. The depth of the silo should be from 13½ feet to 15 feet, breadth about 23 feet, so that a carriage could have no difficulty in turning in it; the length must vary according to the needs of the farm. Silage is best made in cloudy or hazy weather, as too much dryness would be detrimental. It is pitted in successive layers, a little salt being added to each layer of 12 to 14 inches thick. When the fodder is about 3 feet above the level of the soil, it should be again well pressed down by the cattle, and by the men along the sides, and then be covered by a layer of earth or sand of 12 to 13 inches thick. In feeding cattle, the fodder, when pitted, is mixed with chopped straw and beets for the cows; for oxen, sheep, and other animals for fattening, it is mixed with pulp. Green fodder placed unchopped in the silo, and which is perfectly preserved, is given whole to the young beasts and foals, but it must be chopped (when taken from the silo) when it is to be mixed with other fodder.

General rule: for adult animals, mashes should contain one-third dry food.

There is in our mashes about 44 lbs. of pitted fodder per head of cattle. The nett cost-price per ton is based on the estimate what the crops have cost, to which the expenses of loading, unloading, and pitting must be added. For this work, five men load the waggons, whose number varies according to the distance of the land to the silo. The fodder is unloaded, and two men arrange and press it down in the silo. When chopped, as is done at Boulleaume, two men unload and place it on the table of the maize-cutter, two others feed the machine, and another two arrange it in the silo. To the wages of these men must be added the hire of the engine, the day's work of the engineer, and the value of the fuel consumed. Therefore the nett cost-price is about 8*s.* 6*d.* or 9*s.* per acre.* The pitting of the unchopped fodder, with the two men in the silo, would only cost 3*s.* per acre. But in both cases mowing and cartage will be extra. It is well to observe here that in this district the daily wages of a man for mowing are from 2*s.* 8½*d.* to 3*s.* 1½*d.*

The diminution of pitted fodder when whole is about half; when chopped it is a third; we therefore think it best to chop the fodder, as the sinking takes place more regularly, and besides which, there is economy of space.

When a silo is uncovered, 12 to 13 inches of earth must be placed on the fodder, and a strong hay-cock should then be placed above to prevent the water

* The following analysis will show how we divide the nett cost:—

	s.	d.	
Mowing	2	1½	per acre.
Cartage	1	3½	,,
Loading	2	1½	,,
Steam-cutting	2	1½	,,
Pressure (by stamping of men in silo)	0	10	,,
	8	6	

penetrating into the interior of the silo. A covered silo is always preferable, the more so as serving as shelter to the crops and the rolling-plant of the farm.

I visited the Vicomte de Chezelles on January 5th this year, and carefully examined his silo, which presents several points of interest. In the first place, there is the enormous length, 206 feet, without any internal division; nevertheless M. de Chezelles does not attempt to commence filling the whole length at once, but confines himself to a section of about 26 feet at a time. I believe that this method of filling a long silo has not yet been tried in England. Another distinctive feature is the care with which each layer of green food is trodden as it is put in. Men are employed to stamp round the sides, and four heavy draught oxen (weighing probably 15 cwts. or more each), as well as horses, from time to time perambulate the remainder. The result is easily seen in the face of the cutting of the silage, by the depression of the lines of fodder towards the centre of the silo—the result of the superior weight of the oxen. The fodder being thus so thoroughly trodden as it is put in, subsequent weighting is not so important as it otherwise would be. Therefore M. de Chezelles finds it sufficient to cover the fodder with about 12 or 13 inches of earth, using no boards and no weights. The silo is capable of holding nearly 1500 tons, and cost only 400*l.*, including the large barn above. Of course some allowance must be made for difference in the cost of labour in France as compared with England, but probably 25 per cent. would be sufficient on that score—making the cost in England 500*l.*, or only 6*s.* 8*d.* per ton-capacity of the silo, for silo and barn together. It need scarcely be added that a smaller silo and barn would be relatively more costly, because, whatever its size, the silo must have two end walls. In one end of the silo at M. de Chezelles's is a very large and wide doorway, of such dimensions that a cart can back into the silo to be filled with the silage. When the silo is full, this doorway is closed up by means of boards, and just inside about six inches in depth of the silage goes mouldy; otherwise there is said to be no waste, and certainly I could not perceive any. The silage is cut down vertically, but in steps; and this plan enabled me to inspect not only the whole height of the mass, but also its quality at different distances inside. A sample sent to me afterwards consisted of clover, which had been put in long in consequence of an accident to the chopping-machine. It was very aromatic, and pleasingly so. I placed the box containing it in the laboratory, and without any covering, and although examined frequently by visitors, it did not go mouldy for a fortnight. I should add that M. de Chezelles was awarded a gold medal at the last Paris Fat-stock Show (February), for the sample of silage which he exhibited there.

2. *Mons. H. Cottu, La Touché, par Azay-le-Rideau (Indre-et-Loire).*—In making my silos I thought it more practical to have several of medium size rather than a very large one. It struck me that the more limited the space of working, the chances of loss would be proportionately lessened: and therefore that it was preferable to let the greater part of my preserved fodder be well stored without any openings. This decided me to turn a stable for 20 head of cattle into 8 silos, length 10 mètres (33 feet), breadth 2 mètres (6 ft. 8 in.), and depth 3 mètres (10 ft.). They are separated by a wall 40 inches in thickness, which allows the cutting-machines to be set up on one silo or another. I have adopted this plan to facilitate the inspection and preservation of the pitted fodder. My silos are on the level of the soil, but are at the highest part of the farmyard. They have been sunk in a bed of hard tufa, which forms the small hill, at the base of which are my farm-buildings. After the pits had been sunk, they were lined with lime-mortar, on which a layer of Portland cement has been placed. The eight silos form a whole, entirely cemented, and appear to be as one. I made my first trial with a single silo, cemented, and open above. The preservation has been perfectly successful. Earth in this case was the material employed to load the silo. The first cost for digging the eight silos was 260 francs (10*l.* 8*s.*), and 3100 francs (124*l.*) for the coating of mortar and laying on the Portland cement. To that must be added the sum of 1800 francs (72*l.*), the cost of the roofing. According to my calculations, they should last indefinitely, without any appreciable cost for repairs; as to the roofing, or rather the framework, having been made very light, it will have to be renewed in another twelve years; it has already lasted eight years.

I commenced filling the silos on the 16th of September, and finished one silo on the 20th. I shall continue to do so on the 24th of September till my maize crop is completely harvested. I have preserved all crops—hay, sainfoin, lucerne, grass, vetches, rye and oats, green maize, stalks of artichokes, tubers of artichokes, and beets unpulped and mixed with "husks." I preserve especially vetches, rye, and maize. When I took these crops out of the silo, they were nearly in the same state as when they were put in; the maize was a little greenish-yellow, and gave off a strong odour of alcohol. The vetches, lucerne, grass, and artichoke-stalks become a deeper colour, inclining to maroon, and exhale an odour of brown honey. I take and cut the lucerne, vetches, and grass at the beginning of the flowering period, the maize when the panicles of the flowers show themselves *en masse* in the fields at the top of the stalks, and the artichokes when in full flower. I pit them always after chopping. This year, finding myself pressed with work in the spring, I pitted the vetches and rye unchopped. They were well preserved, but the working of the silo has been very difficult for the herdsmen, and the loss to the cow-stalls much greater than with the preliminary chopping; therefore it would have been more profitable if I had chopped them as usual. The average length of cuttings is 1 centimètre ($\frac{2}{5}$ inch). The mass thus becomes more homogeneous, and a certain cubic space being given, I utilise it as completely as possible by cutting up finely, for by this means I am able to store a greater quantity of fodder. When I have, towards the end of the year, some cavings of wheat and oats which have not been used, I have them placed among the pitted maize till they are exhausted. This is done by placing the cavings in large sacks, and the man who looks after the cutting-machine lets one of the sacks of cavings fall in the silo at intervals. The women in the silo mix the cavings with the maize; the mixture is always rich, *i.e.*, with a small proportion of cavings. I also use them before beginning to cut by spreading a layer of them of from 15 to 26 centimètres (6 to 8 inches) at the bottom of the silo. This species of cushion absorbs the juices of the pitted fodder, if any are produced, and is mixed with the latter when the silo is opened. I always add common salt in pitting; not so much to aid the preservation, as to furnish my animals with the salt which they require, and thereby I can avoid placing the pieces of rock salt (always difficult to fix properly) in the feeding troughs.

I put about 400 k. (8 cwt.) into one silo; the sack of salt is lowered into it, and one of the women who is accustomed to do this work, takes about 10 litres (about 9 quarts) from the sack; she sows this salt in perambulating the silo, and recommences the process at the end of a certain time.

I try, as far as possible, to have the silo filled at one operation, and as quickly as I can. I have therefore five women sent into the silo, one of whom sends to the bottom the chopped material, and another arranges and makes it equal, the other three walk about, treading it principally along the walls, and distributing the salt and cavings. By these means I believe I avoid mouldiness, and obtain a perfect and regular fermentation. The upper surface, where it is pitted at intervals, unless it is weighted each time, comes in contact with the air, which penetrates it more or less, and, by contact with the hot gases which rise from the mass, produces rapidly at the somewhat great depth of 20 to 25 centimètres (8 to 10 inches) cryptogamic plants (mould) which are injurious to cattle. I have proved this each time that an accident to the machine has happened; once we had to stop for three or four days, and a whitish layer showed itself along the whole extent of the silo. In a word, the same phenomenon is produced as that which causes the crust of mouldiness which is to be found at the top part of a silo when it is opened.

My silos have perfectly vertical walls, and the angles are rounded: each has the number of planks intended to entirely cover it. The silo filled, the surface is covered with sawdust or cavings: on this cushion, for preventing the ingress of the atmosphere, planks 1 m. 98 (about 2 yards) long and 25 cent. (10 inches) broad, are placed alongside each other, so as to join as much as possible. They are placed broadwise: the end-planks are rounded to the size and shape of the silo. I then put another flooring, placed lengthways, of small planks, of from 75 c. to 80 c. long (30 to 32 inches), to cover thus three of the planks placed broadwise. There are three longitudinal lines of these small planks, one in the middle, and one along each wall: these three lines of planks support the weights, which consist of stones, and distribute the pressure equally over all the rest (Fig. 15, p. 216, VI.). The outside planks are more heavily loaded than those in the middle, as the air has more tendency to pass along the walls. This "*modus operandi*" has the advantage of allowing two or three planks at each time to be taken off: *i.e.*, exposing only a quantity sufficient for the consumption of three or four days. I estimate the pressure of the stones at 500 kil. the square mètre (about 100 lbs. per square foot).

By the system above described the pressure is continuous, as the planks can be made to slide easily along the walls, and follow the subsidence of the pressed mass: the pressure only ceases when the last cut of fodder from the silo is given to the cattle. This mode of proceeding has appeared to me preferable to the use of earth and other means, as the removal of the stones, &c., is easy and rapid, and the pressure remains the same. I cannot reply with precision to your question as to the weight of crops put in and taken out. I think the weight must have varied very little, as the humidity appeared similar at the time of opening the silo to what it was when the crops were chopped and pitted. As to the cost of filling and emptying the silo, I may say that I bargained for the whole work by the piece, viz., harvesting, loading the carts, cutting, &c., in silo, at 70 francs (2*l.* 16*s.*) per hectare (2½ acres, and therefore about 22*s.* per acre). I furnished two horses and a mowing-machine, also two horses and carts. It can, however, be done cheaper; six men and four women are sufficient for the maize-mowing; women collect it and put it into sheaves, which the men bind. Two men are necessary to load the waggons; at the silo three men are necessary to supply the man who feeds the maize-cutter; finally, there are five women in the silo: under these conditions a hectare of maize can be cut and mown per day. The men's wages being 3 f. 50 c. each (2*s.* 9½*d.*), and that of the women 1 f. 50 c. (1*s.* 2½*d.*) each, the total for labour is 55 fr. 50 c. (2*l.* 4*s.* 4*d.*) To this must be added the cost of the horses, the wages of the

carman, and the consumption of fuel by the engine, equal 30 fr. (1*l.* 4*s*; making a total of 3*l.* 8*s.* 4*d.* for 2½ acres). The cost of the planking for covering the silo is 32 fr. 50 c. (about 1*l.* 6*s.*), and the planks are 3 cm. (a little more than 1 inch) thick. As to the stones, they cost 30 fr. (1*l.* 4*s.*) the 8 cubic mètres: and no more than this quantity was used to load the silo.

The cost of emptying the silo is insignificant. When a silo is opened, the man raises the stones which load the three small planks at the end of the silo to compress the three large planks placed broadwise. He places the stones on the platform which separates it from the neighbouring silo, then he raises the three big planks, and takes off next the crust of the surface of the silage, composed of sawdust and a little fodder, packed and mouldy, where the gases from the mass have fixed themselves. He takes each day the necessary quantity by cutting down vertically as in a haystack: the remainder of the silo remains loaded as before. Arrived at a certain depth, he takes a ladder, and, by means of a large basket, fills his small cart (or waggon) with the pitted fodder. This cut having gone to the bottom of the silo, more stones are taken off: the small planks are removed by sliding them, and one of the big planks is raised, and the cut thus commenced is similarly continued to the bottom. Thus the mass is always loaded; the cut in use hardly lasts beyond two days, and if there is old hay to be consumed, the cutting can be done easily even above the silo, and the mixture with the pitted stuff arranged conveniently at the end of the cleared-out silo, even at the very bottom of the cut.

The results obtained from the process of ensilage are considerable; and I will give them in detail. My property, when I bought it in 1871, consisted of 16 hectares (40 acres), and maintained 5 cows. Thanks to ensilage, I am now able to keep 16 milch cows, a bull, and 4 or 5 young breeding beasts. I have besides 6 horses, whose entire fodder and two-thirds of their oats are grown on my estate. Finally, the sale of wheat pays for half of the artificial food that I buy for my cattle. These results induced me to purchase last year a neighbouring estate where I could place my young stock, my present space not being sufficient at present. I possess now 22 head. Each year a portion of my land of between 4 or 5 hectares in extent is put aside exclusively for the feeding of my cows, and it amply suffices. The remainder of my estate is devoted to meadow, corn, and artificial grasses, which do not form a part of the food of the cows, or at least no appreciable quantity; for example, the turning out and folding for two hours a day on a meadow which has already been twice mown. This numerous herd has enabled me to manure my land richly, and to obtain some very good crops; finally, these animals, regarded as milk-producers, give a remarkable profit. Again, we must credit ensilage with the perfect regularity with which the rations of food can be obtained, and which allows us to serve out always a full quantity to the animals, an important point, the advantage of which has been shown by my weighing-machine. When a silo is opened, a small specimen is taken out and analysed, and after analysis the ration is compounded according to the age of the animals, from the triple point of view of nitrogenous matter, of fatty matter, and extractives. I can support this opinion by the weekly weight of the animals bred on my estate and fed exclusively on this food. A heifer born on the 22nd of March, 1880, the complete weaning being finished on the 25th of July, weighed on that date 197 kil. From week to week the following are the weights: 205 kil.—218—230—230—242—250—260—266—281—296—295—301—309—313—314—319—330—335—340—349—350—360—369—371—374—382—389—401—403—400—409—418—429 (the 20th of March). I must ask you to pardon me for not sending the weights of the second year, but the 28th of March, at two years six days old, the beast weighed 733 kil. Not having bred, she was sold to the butcher for 700 francs (28*l.*) on the 1st of June, 1882, weighing 770 kil. (about 15 cwt. 1 qr. 14 lbs.), and gave 470 kil. (about 9 cwt. 1 qr. 14 lbs.) of meat.

This beast never was put up to fatten, but received only the ordinary rations of the other cattle. At the present time, I have 4 heifers: one, a yearling, weighs 340 kil.; another, 1 year and 7 months old, weighs 454 kil.; another, 1 year and 3 months old, weighs 425 kil.; and the last, 11 months old, weighs 289 kil. I may observe that in January 1880 I published, in 'Le Journal d'Agriculture Pratique,' all my tables of rations. Finally, silage is, during the whole year, the basis of the feeding of the cattle on my estate, and yields me results, several examples of which I have cited.

I have never found in the silage any special results attributable to the succulence of the crops when pitted. The succulence of crops cannot, I fancy, influence the preservation, different agencies alone can influence it. I beg to hand you my observations: some frozen maize, that is to say, some that had been completely exfoliated by an early frost, pitted on the 28th of October, 1881, and analysed the 3rd of December, 1881, gave a nutritive value of $\frac{1}{6 \cdot 1}$,* *i.e.* an almost complete ration, when eight other analyses made in 1877, 1878 and 1879, 1880, and 1882 have never given a nutritive value higher than $\frac{1}{9 \cdot 05}$; it is therefore evident that the frost, by killing the leaves, left only the stalks, which is much richer in sugar. The richest silage that I have made was with sainfoin, the analysis of which showed the nutritive value to be $\frac{1}{2 \cdot 83}$; this was rather too rich.

In spite of different opinions, I have no doubt that the pitting of wet fodder has an injurious effect on its fermentation. The rain-water which brings principally ammoniacal nitrogen (Schlœsing) into the silo introduces a principle which may turn the mass acid. When the crops are very wet, the fermentation becomes butyric, and the mass gives off an unwholesome smell. The animals will sometimes eat it, but only when pushed by hunger. Acidity in this case increases rapidly during the period of consumption; I will even say that it is good to avoid the dew, and if anything can add to the success of the preservation, it is,—I will not say making hay of it in the sun,—but allowing it to fade, and get rid of all its outer humidity.

The proof of this fact has been recently given in a pitting of rye and vetches. Rain had wetted a part in the fields; the pitting was begun under good conditions, and the fodder in the bottom of the silo was good; where the fodder had been pitted wet, the cut presented a black stripe, well defined, and the smell of which was acid. The bottom portion had a good alcoholic smell: the upper part made with the same crops (but which had been cut in the morning and pitted only in the evening, because we were stopped the evening before by rain, and I did not wish to bring back the whole of my workpeople the next morning, so as to finish at once), had received the morning sun, was thus rid of all dew, and had a smell of burnt sugar really succulent. It cannot be attributed to the place occupied at the top of the mass, this last part being more than 80 cent. (32 inches) in thickness. The contents of each of my silos last about three months, without deterioration; but, as I have explained above, the fodder is only consumed according to the requirements of the farm. Each year in June and July I buy grains from a brewer at Tours, and put from 12 to 15 tons into a silo. For this purpose, one of my silos is divided into three parts; I generally fill only two. This silo is covered and weighted like the others: it is put in use almost immediately after being filled, and thus lasts five or six months without appreciable loss, but only a small cut of the whole depth is taken each day. It has often happened that, having a careful man, I have had, at the time of renewal of my stock of grains, some of that which had been

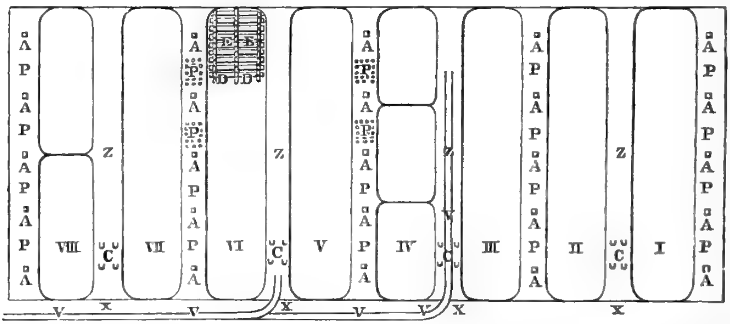
* I should explain that this system of expressing the nutritive value of food means that the fodder contains one part of digestible matter to a certain quantity not available as food.

in use for five months, and it was perfectly good. Care must be taken, especially with regard to the grains, to leave no remnant or spoilt portion of the above in the bottom of the silo. The greatest care, in fact, must be observed in this particular.

There are several reasons for the variations in the keeping qualities of pitted fodder; firstly, the pressure is a great cause of long preservation, and should last all the time and up to the last moment; then the greater or less outer humidity of the crops at the time of pitting. The pitted fodder when wetted becomes acid immediately, if it is not so already, and blackens on contact with the air. Finally, another case, rarer, and which only shows itself in the ensilage of rye, is the dry rot. When rye has been cut a little too late, the most energetic pressure is unable to crush the thousand little pipes formed in the stalks. On opening the silo the air penetrates the whole mass, which, not having had sufficient internal humidity to set up its fermentation, is sometimes even heated. The access of the air produces combustion, and there is nothing but a light, felt-like, whitish mass, full of fungi, and fit only to be thrown away. All pitted crops in full sap, without much external humidity, I will say even with as little humidity as possible, can be well preserved, and retain a good odour for several days after having been cut, even if the working face of the cut is left exposed for some time.

I enclose a plan of my silos; their arrangement, mode of covering, and the pressure used.—*September 22nd*, 1883.

Fig. 15.—*Plan of M. Cottu's Silos.*



A. Posts supporting roof.
C. Fixed hooks to attach or hold the maize-cutter.
D. Large planks covering the silo.
E. Small planks placed longitudinally and supporting the stone weights.
P. Places for storing the stones when not in use.
X. Position of steam-engine when working the maize-cutter.
V. Lines of railway leading to the cow-houses.
Z. Separating walls.

Below, I beg to hand you an analysis of sainfoin, in which lucerne predominated:—

Water	74·49
Ash	2·87
Albuminous matters	4·57
Fat	0·61
Non-nitrogenous matters	11·39
Cellulose	6·07
Total	100·00

The following is the analysis of the same fodder fresh, taken from the Tables of M. von Göhrer, which gives an approximate idea of the change that fermentation has produced in the fodder:—

Water	75·3
Total dry matter	24·7
(Ash in 100 parts of dry matter 7·46)	
Albuminous matters	4·5
Fat	0·7
Non-nitrogenous matter	8·4
Woody fibre	9·3

This analysis differs very little from that of pitted fodder. I believe that the difference bears principally on the digestibility of the materials rather than in the change of the matter itself. I have also undertaken an enquiry into the fermentation of these fodders, which I shall have pleasure in communicating to you when it is finished.

3. *Monsieur E. Lecouteux, Château de Cerçay, par La Motte Beuvron (Loir-et-Cher).*—Silage at Cerçay is made in a barn, which becomes disengaged in September, after the corn has been threshed. It is on a level with the soil, which rests on a subsoil too damp in winter for digging or pitting under-ground. The size of the barn is as follows:—

Length, 13½ mètres (15 yards) } square surface 74 mètres (90·4 sq. yards).
Breadth, 5½ do. (6⅓ yards) }
Height of the pitted vegetable mass, 4 mètres (4 yds. 1 ft. 4 in.).
{Cubic total before pitting, 296 mètres (405 cub. yds. 17 cub. ft.).
{For both of the two barns serving as silos, 592 mètres (811 c. yds. 7 c. ft.).
Ditto after pitting six weeks, 444 mètres (608 c. yds. 12 c. ft.)

There are three bays in brickwork. That in the middle measures 5½ mètres (6⅓ yards), and those at the ends 4 mètres (4 yds. 1 ft. 4 in.) each. Total in the longitudinal axis of the buildings, 13½ mètres (15 yds.). They are marked by pilasters of 45 cm. (about 1½ ft.) to the square. The walls between the pilasters are 35 cm. (14 inches) thick. The roof is slate, costing 4 francs the square mètre (3½*d.* per square foot). The brickwork cost 20 francs the cubic mètre (11*s.* 8*d.* per cubic yard). I estimate the building to last forty years at least. In each year I use it both for housing cereals and for the pitting of maize. Last year, the last named operation was done between the 20th and the 30th of October.

I sometimes pit pure maize; sometimes maize mixed with chopped straw, dry hay, and threshed vetches; sometimes maize mixed with green meadow grass, clover, lucerne, &c. The maize is harvested nearly ripe, when the corn is half-milky (*demi-laiteux*), and when the fingers can crush it. *Trifolium incarnatum* is harvested when in full flower, and the late cut of lucerne just before the flowering, which, however, last year did not come, as the late season was against it. The maize is cut into about 2 to 4 cm. (2½ cm. = 1 inch) lengths, but grass is not cut. I do not use salt. It is only useful when damaged crops are mixed with other fodder, and pitted together. In such cases it will improve the damaged fodder. Each of my silos is filled in three or four days. When from bad weather or other causes it is impossible to fill the silo quickly, there is no need to worry oneself. The sinking is better, and by this means a greater quantity of fodder can be pitted. Nevertheless I prefer to pit quickly, and put it together very high (4 and 5 mètres). The heap of maize will be the more reduced in height the greater the quantity piled up. Evidently the upper layers press down the lower ones. The maize thus compresses itself. In this way I obtain a first pressure. What is good for maize also holds good for other pitted materials.

To perfect the first pressure, I place a layer of stones, bricks, or heavy material on the maize. These weights lie on planks placed at various distances. On these I finish my covering by placing trusses of straw. I estimate that a load of 300 kilos (6 cwt.) per square mètre (61 lbs. per square foot) is sufficient to obtain a good result. Under the above conditions the sinking will have taken place in about six weeks.

In 1883 my two silos received—

Maize	473,000 kilos	(473 tons).
Straw and chopped grasses	5,000 „	(5 tons).
	478,000 „	(478 tons).

Weight per cubic mètre before pitting .. 800 kilos (16 cwt.), or 48½ lbs. per cubic foot.

„ „ when used .. .. 900 to 1000 kilos (18 cwt. to 1 ton, or 54½ to 60 lbs. per cubic foot).

The cost per hectare of harvesting and pitting maize is as follows:—

	Per Hectare.				Per 1000 Kilos.		
	Francs.	£	s.	d.		s.	d.
Reaping	9	0	7	1½	0·19	0	1¾
Cartage	36	1	8	8½	0·76	0	7¼
Loading	28·80	1	3	0	0·61	0	5½
Chopping and filling silo	23·91	0	19	0	0·53	0	5
Labour in silo	10	0	7	10½	0·25	0	2½
Chopping straw, &c., in addition ..	2·40	0	1	10½	0·05	0	0½
	110·11	4	7	7*	2·39	1	10½†

* Equal to 35*s.* per acre. † Equal to that amount per ton.

The maize harvested occupied 10 hectares (25 acres) of ground. Each hectare gave 47,360 kilos (47 tons 7 cwt.). The silage for use is taken daily from the silo by vertical cuts. The great result of ensilage at Cerçay, on an estate purchased at 400 francs the hectare (6*l.* 8*s.* per acre) twenty-five years ago, is that it has enabled me to base the winter-feeding of my cattle on a crop which is perfectly fitted to the climate, which produces a large bulk of fodder, and which needs, above all, phosphatic manures (*i.e.* the least expensive manuring material), and which, finally, is alike useful for the production of milk and meat, and for the maintenance of draught animals. Without maize, the basis of feeding my cattle would be gone; or, at least, I should be able to maintain only very few. The cultivation of maize requires less labour than that of beets and other roots. In a late and during a wet season, the reaping of the after-crops is both difficult and costly. The process of ensilage has rendered me very great service by enabling me to convey my after-crops, quite wet, into my maize-silos, upon which fermentation produces a homogeneous and succulent mass. Vegetable moisture contained in green crops has never created difficulty, or occasioned me loss. Rain never stops ensilage; but the work-people do not like to carry the maize wet in the fields on their backs. Rain does not affect the preservation of the maize. The ensilage of *Trifolium* cut in June, when in full flower, is a grand expedient for getting over the months (often dry and burning) of July and August, when the crops resist in a very small degree the sun's heat. In this case the enemy is outstripped. When it comes, that is to say, when all above is burning, the early crops are being preserved in the silo.

When, by pressure, the fermentation of pitted fodder does not surpass the degree of an "alcoholic fermentation," the only deterioration that takes place is in the parts touching the sides of the silo, or at the top of the mass. To say that there is no fermentation, would be to deny the existence of the natural laws which govern accumulations of vegetable matter. There is heat, introduction of the atmosphere, escape of gas, and fermentation. The essential point is that the fermentation should stop at the proper time. I have never remarked changes arising from the vertical cutting when the silage is being used. Then, the fodder is well packed, and the emptying can last two months without the material being deteriorated. It is, of course, understood that the silo must be emptied precisely in accordance with the progress of the cutting. I attribute successful results of preservation to the settling and pressure of the material from the beginning of the process. All crops can be pitted green. The possibility of this should induce agriculturists to devote two and three times the area of land to the growing of these crops, although there may be no longer any necessity to consume them almost the day they are harvested. They can be pitted for use during the winter, and even sometimes, in the case of early crops, they can be kept for consumption during the dry season. *Trifolium* is among these last. Ensilage, in fact, has totally changed the question of green crops. As to the feeding-value of pitted maize and other green crops, it would be difficult at present to give the exact figures. I believe that it is excellent for milch-cows, draught oxen, and fattening beasts.*—*January 18th*, 1884.

On the 1st of October, 1883, I witnessed the filling of one of M. Lecouteux's silos, having on previous occasions witnessed the utilisation of a portion of the contents of his and neighbouring silos. The only remarks which I find it necessary to make are, (1) that, owing to the use of Albaret's centrifugal cutter, one man was enabled to keep the maize equally spread over the silo; (2) that the whole of the work was stopped for half an hour before each meal-time, and for that interval everybody employed in the business was sent into the silo to stamp down as much as possible what had been put in since the last "*promenade*," the women being specially told off to tread the portions nearest to the walls; (3) that the weighting material consisted of bricks laid upon boards, and very carefully arranged.

Our well-known honorary member, M. Lecouteux, is the author of one of the best books on the subject. It is entitled 'Le Maïs, et les autres fourrages verts: Culture et Ensilage.' The second edition was published in 1883.

4. *M. de Monicault, Versailleux par Villars-les-Dombes (Ain) France.*—I have two twin silos (*i.e.* a double silo), each being 24 mètres (80 feet) in length, 3 mètres (10 feet) in depth, and one $2\frac{1}{2}$ mètres ($8\frac{1}{3}$ feet), and the other $3\frac{1}{2}$ mètres ($11\frac{2}{3}$ feet) in breadth, representing for both a capacity of 432 cubic mètres (say 16,000 cubic feet). One-third of each silo is above the soil, and two-thirds below. The bottom and sides are constructed of concrete. They have no permanent roof. They are economically made, and their form is

* The maize-cutting at Cerçay has been done this year with the centrifugal cutter of Albaret. This instrument is greatly suited for silos which are filled from above (see pp. 224 *et seq.*)

rectangular. They are filled very easily by bringing the fodder to them direct; and an easy ascent, starting from the bottom of the silos, allows the little vehicles which carry the fodder to the cattle-troughs to be easily filled. I estimate the cost of making the two silos at 2400 francs (96*l.*). The time they will last depends upon the quality of the concrete, and that is indefinite when the work is well done.

I filled the silos in May and September, the maize having been put in about the 20th of September, and meadow-grass, and various spring crops at the earlier date. I pit the crops when they are green, and at the commencement of their flowering stage. Grass and other spring crops are put in whole, but maize is chopped completely to a length of about 2 centimètres (not quite 1 inch). Neither salt nor straw is mixed with the pitted fodder, and the silos are filled as quickly as possible, but at several intervals; and each time the materials are well trodden. To obtain good results, the fodder should be pitted as quickly as possible; but by filling the silos at various intervals, they are better turned to use, because a greater quantity of fodder can thus be stored in them. Each silo is filled in less than a week. I weight the fodder each time I place any in the silos, by first having it covered with planks, and then loaded with big stones, to the extent of 400 kilogrammes at least per square mètre (say 80 lbs. to the square foot). The weight of the crop put in is nearly the same as that of the pitted fodder taken out. The fodder is cut down vertically, like hay in a stack. I have found the process of ensilage to be an economical way of preserving crops, and to give the advantage of a green food in all seasons; and especially in my case it enables me to grow maize on a large scale. A proper proportion of this pitted fodder introduced into the daily rations of the cattle is a beneficial practice for milch cows as well as breeding and fattening animals.

When the fodder has been properly preserved, it can be consumed as required, without any fear of perceptible deterioration. It is always better to cut only a slice from the silo, in proportion to the daily needs of the farm. The silo need not be opened more than every two or three days, but I take from mine every day. Good preservation of fodder depends entirely on: (1) The state in which the fodder has been harvested and preserved; it should not be in a too matured condition. (2) An energetic consolidation.

It appears to me that the pitted fodder ought only to constitute a portion of the food of the cattle, and not the entirety. In the proportion of $\frac{1}{3}$ or $\frac{1}{2}$ of the total nutritive value, its employment is advantageous. I mix the pitted fodder with the dry food, namely, hay and straw previously chopped up. But it is necessary that each farmer should make comparative trials; for as with hay, so it is with pitted fodder, according to the seasons, and the skill employed, fodders of different values will be obtained. Ensilage, as I have already said, furnishes me economically and at all seasons with a green crop. It lightens our hay-time; and permits me finally to get in the greater part of the green maize-crop. The instrument for chopping the maize must be powerful; and the centrifugal cutter of M. Albaret is the only one in my opinion which gives a good result.

5. *Mons. le Comte Roederer, Bois Roussel, par Essai, Dép. de l'Orne.*—I have four silos, of different sizes, containing from 120 to 200 cubic mètres each, and all below the level of the soil. They are built of stone or brick, cemented, and were dug inside a building already existing. I have experimented with silos simply dug out of a dry soil, and filled with grass. The fodder, covered by earth, kept very well, but I did not continue the use of this method, my built silos being sufficient for my purposes. It is difficult to state the cost, almost none of the materials having been bought. With careful repairing they may last a great many years. The largest was filled this year (1883) in May;

the others will be put in use in September and October, according to the weather and the ripeness of the crops.

I preserve by ensilage beetroots, green maize, clover, lucerne, sainfoin, vetches, grass from the lawns, and in fact every kind of green fodder having sap enough to ferment. The crops are cut ripe, and when full of sap, and are generally chopped before being put into the silos into about one inch-lengths. I leave them unmixed with other materials, considering any addition superfluous.

The silos are filled at intervals, but only of a few days' duration, my reason being that the principal purpose being to exclude air as much as possible, it is better attained by leaving the pitted materials a little time to settle more firmly. During the filling, several times every day, the work-people employed on this operation are sent to walk all together on the surface. When the silo is entirely filled it is covered up, first with grass of the worst quality, destined to protect the silo, and to be thrown away, and over it a great quantity of rough stones, as heavy as possible. The average weight of the green crops can be estimated at 1000 kilogrammes (one ton avoirdupois) per cubic mètre, and this is reduced about a fifth part by fermentation.

Each 100 cubic mètres generally requires 8 days' work of men, 12 of women, 4 days of the steam-engine, and 1200 kilogrammes (24 cwt.) of coals. The expense of mowing is always the same; the bringing home of the crops is more or less expensive, according to the distance of the field. One day's work is enough for covering the fodder with stones. The cost of emptying the silos cannot be accurately estimated, this work being done daily by the herdsmen in charge of feeding the cattle. They take it in layers from the top.

The best results have been obtained by me with this system. In rainy seasons, when hay could not be dried, I have saved crops in considerable quantities.

I have not found any result specially attributable to succulence of the crops, or to external moisture upon them, except on one or two occasions, when too young grass was brought in quite dripping from rain, and even then it was not entirely spoilt, and could be consumed. The worst condition is when too dry, the sap necessary for fermentation being then wanting. The pitted fodder will keep for months, if only taken out with care, that is, taking it by layers, and not in the same place, so that the surface does not remain too many days in contact with the air. Pitted fodder, when well prepared should, in fact, *always* keep wholesome for months (even years, if air is entirely excluded). Mould can only be attributed to two causes (1st) the state of the fodder when pitted, viz., if too dry or already rotten, (2nd) if the pressure has been insufficient, and air has been left inside—exclusion of air being the most important, I might say the only, condition of success.

The cattle I usually keep number generally from 130 to 150 animals: 80 or 90 of them taste no other food than fermented grass during four or five months in winter. They could not be entirely fattened without an addition of oilcake or farinaceous food; but they are all in very good health and condition, and eat this food more greedily than the hay and straw on which the cattle of my neighbours are sustained during the winter months.

Count Roederer being one of the pioneers of this system in France, as already stated, I visited him on September 24, 1883, and carefully investigated his mode of procedure. His silos, within old buildings, are very deep excavations lined with brickwork, and were originally intended for the preservation of beetroots and mangolds in straw during the winter. The

process of ensilage adopted by Count Roederer is sufficiently described above, but there are two other points worth notice. Firstly, I saw a quantity of silage of the 1882 crop at the bottom of one of the silos, without any covering whatever. With the exception of a thin layer of mould at the top it was perfectly good, and Count Roederer has since informed me that this remnant was eaten during last winter by his cattle most greedily. The second point that I noted was an ingenious arrangement for hoisting the silage from the bottom of these exceptionally deep pits. It may be briefly described as follows:—An inclined tramway leads from the top to the bottom of the silo, and upon this runs a small waggon with the hinder wheels much larger than the fore ones, so as to keep the waggon more or less horizontal, and to lessen the draught. The ascent of the loaded waggon was managed by a chain, wound up by a large hollow treadwheel, which could be worked either by a man or a horse. One of Count Roederer's visitors put this apparatus in motion for my special benefit, and I was rather astonished at the comparative ease with which the work was performed.

The silos of M. Goffart, at Burtin, in the Sologne, have been so often described, that it is unnecessary to say much about them here. I visited M. Goffart in Paris at the end of last year, and went to Burtin on January 7th this year. It is well known that M. Goffart has of late years retired from farming, and that of his three silos only one is now filled annually, and that with chopped maize. The silos are partly above and partly below ground, and the method adopted for emptying them is a sort of compromise between the system of taking the silage off in horizontal layers and that of cutting it down vertically. In other words, when, say, two or three boards and the superincumbent weights are taken off the top of the silage, it is cut down to the level of the ground, and the boards immediately and carefully placed upon the surface of silage thus exposed, so as not only to prevent any long contact of that surface with the air, but also to continue the pressure by using this covering of boards to the lower portion as a roadway to the exposed face of the upper half, the stones and other weighting material being also employed for the same purpose, except in the line of traffic. This struck me as being a very ingenious and sensible arrangement for emptying a silo built partly above and partly below ground. As M. Goffart has stated that his pitted maize does not ferment until after it has been exposed to the air for some hours, I was at particular pains to investigate this point, and took away with me a boxful of silage that had not previously been exposed to the air. It required no chemical analysis to show that M. Goffart's maize was a sort of *sauer-*

kraut; and the only explanation of his statement as to non-fermentation that I have been able to arrive at is, that he does not consider lactic fermentation any fermentation whatever, probably because there is no development of alcohol. I should add that the sample was found to contain 78·8 per cent. of water, and that it has kept well ever since.

B. The Netherlands.

6. *Heer J. van der Breggen, Waddinxveen.*—The silo is a sextant, measuring 20 feet each side and 13 feet in height. It is entirely above the level of the soil. Formerly it was a corn-stack (*Zuid Hollandsche hooi of koornberg*). They all have, as is known, a permanent roof of thatch. All the sides (six from post to post) have been planked up to about 4 mètres in height, equal to 13 English feet. No experiments without durable or permanent roof have been made. Its original cost was 240 Dutch guilders (about 20*l.*) for each corn-stack. They now have been used two years, and are still as good as if they were quite new. I fill the silos at any time when I have a field ready for mowing, so that they are all filled during the summer and the autumn, chiefly with grass, but also with leaves of beetroots, some tares and rye, always in a green state, and not at all ripe. Everything is pitted in a whole state, chopping not being usual. Salt is mixed to the extent of about one part to 1000, and being used always for the cattle in winter, it is thus mixed with the fodder. The silo is filled as quickly as possible; sometimes it takes two or three days; then it is pressed, and then perhaps in a fortnight there is again some grass that ought to be put in the same silo: we take off the covering or compressing material and fill again in the same manner. I use my altered corn-stacks because I believe it much cheaper than the nice silos of bricks that M. Goffart uses in France. It would also be somewhat difficult here in Holland to have silos in the ground, or below the level; our country is too low, at least in this part of the Netherlands. The fodder is always compressed by putting upon it heavy materials like sand, stones, or clay, or anything that might be obtained and found heavy enough to compress it. No mechanical contrivance for pressure has been employed. By my procedure, from 65 to 75 per cent. of the weight of the crops put in will be the weight of the grass fit for use.

All wages for mowing by machine and carting home, filling the silo and covering or compressing the contents, will be about 1*l.* per hectare (about 2½ acres). Of course nothing is reckoned for horse-power, nor for agricultural machinery. The cost of emptying need not be reckoned, as the cattle-men take off daily what they want for their cattle. The emptying is done in the same way, like hay in a stack, vertically. I have ascertained that it is possible to use every green food by pitting it, in a profitable way; by hay-making, on the contrary, one is not sure of getting fine hay, in consequence of the wet seasons. The wetter the crops, the sourer the pitted fodder will be; also the more juice will run from the silo. The dryer the grass, the more change for mould in the silo. I have always pitted my crops immediately after mowing them. I always have the contents of my silo consumed directly after it has been opened. Therefore I have no experience with regard to keeping qualities.

I have never tried pitted or other fodder without concentrated food, and I should not think that pitted fodder without substantial food would do for cattle, as I like them to give a large quantity of milk, and to have plenty of flesh on them.—*January 4th*, 1884.

Combined Chaff-cutters and Elevators.

1. *Mons. Albaret, Liancourt, Oise.*—This maize and fodder-cutter has been specially manufactured by us for cutting maize, which, however, does not prevent it cutting straw and other fodder-crops with the same facility. It is composed of a cast-iron table mounted on a solid oak frame. On this table is a kind of box, also in cast iron; with the transmission of movement it forms really the essential part of the maize-cutter. Two rollers of a large diameter (10 inches), and consequently very heavy, run across this box; they carry projections necessary for the seizure of the maize. The lower roller is fixed, and turns in its supports. Those of the upper roller slide in the grooves arranged in the two sides of the box, which hold and guide them. Consequently these supports and the upper roller can rise and fall at the same time, being parallel, whatever their position. Above this roller is an iron lever on which is placed a counterpoise, which can be moved at will, so as to obtain a variable pressure on the fodder to be cut.

The upper roller is moved by the lower, whatever its position, by means of a chain, which rolls on two teethed pulleys, wedged on the shaft of the rollers. It turns the opposite way to the one which moves it.

This chain can be stretched when it is lengthened by use by displacing the axletree of the roller, which is well held in a slot-hole, and which holds the chain in its proper position. The speed of the rollers can be regulated by means of a lever within the reach of the persons who feed the machine. This lever governs a coupling arrangement, which allows the maize, &c., to be rejected, should a strange body be introduced with it. The position of the lever corresponds with the instantaneous stoppage of the rollers.

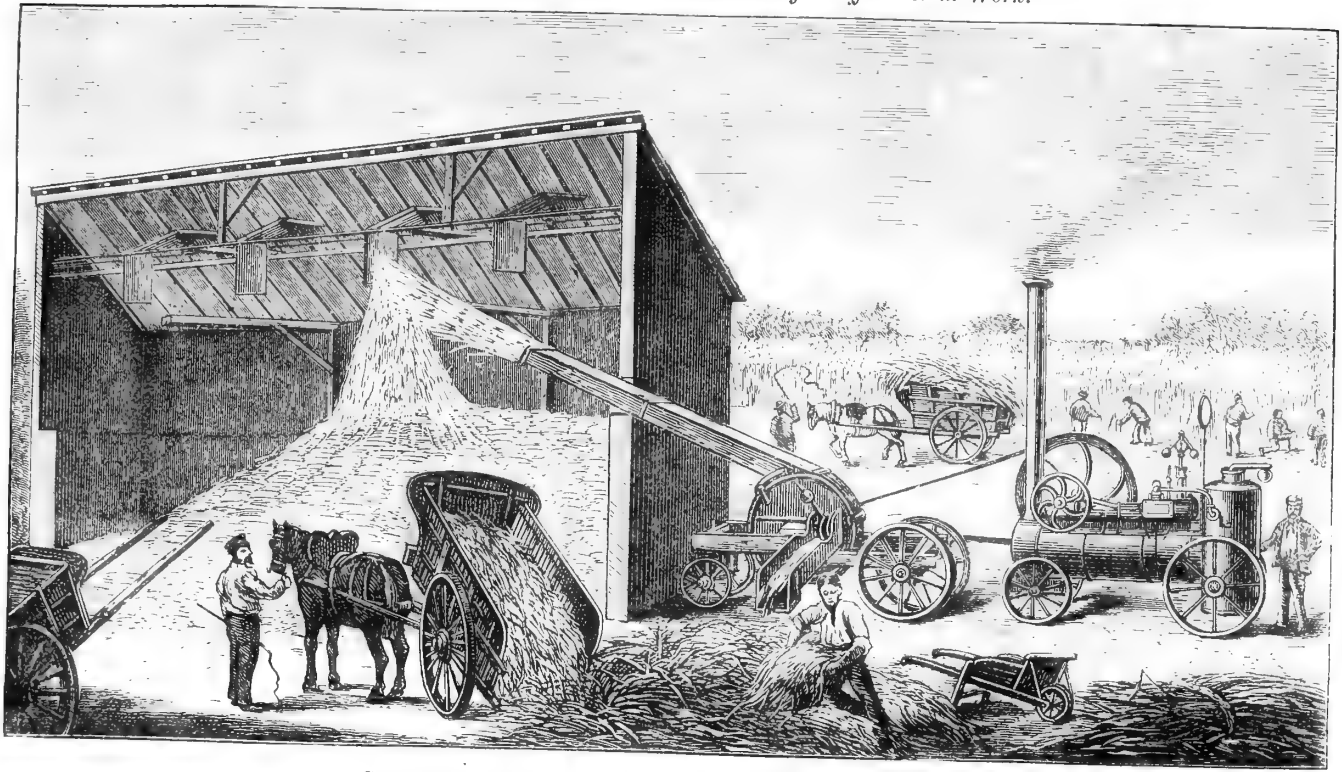
A straight gear, that can be easily thrown out of work, can engage successively four straight wheels. The fly-wheel, working four knives, cuts the maize a length of about $1\frac{1}{4}$ inch, $\frac{3}{4}$ inch, $\frac{1}{4}$ inch, or $\frac{1}{8}$ inch, according as the gear governs the 1st, 2nd, 3rd, or 4th of these wheels. If the flywheel works two knives, the lengths would be just double. A very large amount of work can be done with this machine.

The engraving (Fig. 16) shows that the whole instrument is mounted on four solid metal wheels, which allows it to be transported wherever required, which is indispensable for ensilage and many other uses. So as to facilitate the feeding of the machine, and to make a saving in the cost, it possesses an automatic "entraineur," or seizure formed by a kind of endless platform, made of small boards, mounted on two chains, working on two parallel shafts, one of which is governed by the lower roller. This platform forms the bottom of the hopper, and its speed is always the same as that of the rollers, and its movement is always the same way. The feeder has therefore only to place the fodder in the said hopper, without being obliged to push it to the rollers. The work is thus more regular, less heavy, and requires fewer workpeople.

The aim of the centrifugal elevator, with which the machine is provided, is to be able to load, in an economical way, the silos, or carts, with the cut matter according to the rate of cutting. It can also be used for shooting the fodder into store-houses, &c. It is composed of a cylindric envelope surrounding the fly-wheel. This envelope is shut on either side so as to enclose the knife working the fly-wheel, which also carries iron paddles fixed on cast-iron projections. A tangential conductor completes the machine, the whole forms a kind of large ventilator. The fodder cut by the knives falls into the box, with which the maize-cutter communicates. There, submitted immediately to the palettes, and the powerful blast produced by them, it is shot out through the tangential conductor.

In the centre of the box, and also in front, is an opening allowing the entry of the atmosphere. Its dimensions can be changed at will easily by means

Fig. 16.—*General View of M. Albaret's Elevating Chaff-cutter at Work.**



Copied from the 'Journal d'Agriculture Pratique,' Jan. 31, 1881.

of two sliding doors, which can be removed so as to clean or repair the knives or box. Another sliding door is placed on the opposite side, to facilitate the unmounting of the knives; finally, an opening at the bottom serves to empty the drum.

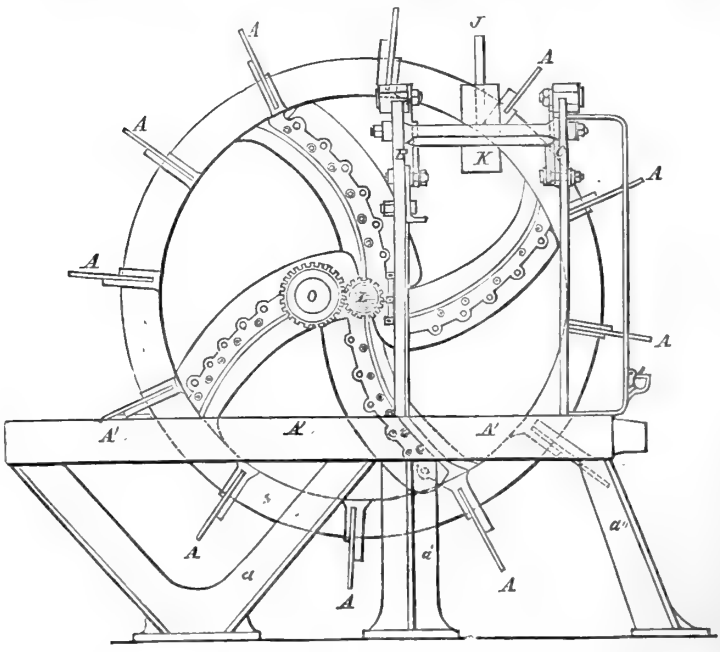
The upper part of the box and the conductor are so made as to be removed with ease. The latter is moveable, so as to shoot the fodder at variable heights, according to those of the carts, where it is wished to place it. It can also be made shorter or longer. The machine possesses a lever for throwing the motive band out of gear. It is provided with a wooden sabot, acting as a brake on the pulley, so as to stop almost directly the fly-wheel, whose ordinary speed is from 300 to 400 revolutions a minute.

To the foregoing technical description of the makers I add the following from my own observation at Cerçay:—

The general appearance and method of using this machine are clearly shown in Fig. 16, in which the steam-engine is seen to be driving what is in reality a large chaff-cutter enclosed in a box furnished with a spout, through which the chopped materials are projected into a silo or barn, as the case may be. From the roof of that structure flap-boards are hung, and as these are brought into use, either by altering the inclination of the spout, or by bracing up one or more of the flap-boards, so the chopped material can be distributed at pleasure.

The longitudinal section (Fig. 17) and the transverse section

Fig. 17.—*Longitudinal Sketch-section of the Cutting and Elevating Wheel of M. Albaret's Elevating Chaff-cutter.*



(Fig. 18) of the interior of the box, explain in detail the nature of the mechanism, by means of which this result is obtained. The cast-iron table, A′, rests on three feet (a, a', a''), and supports

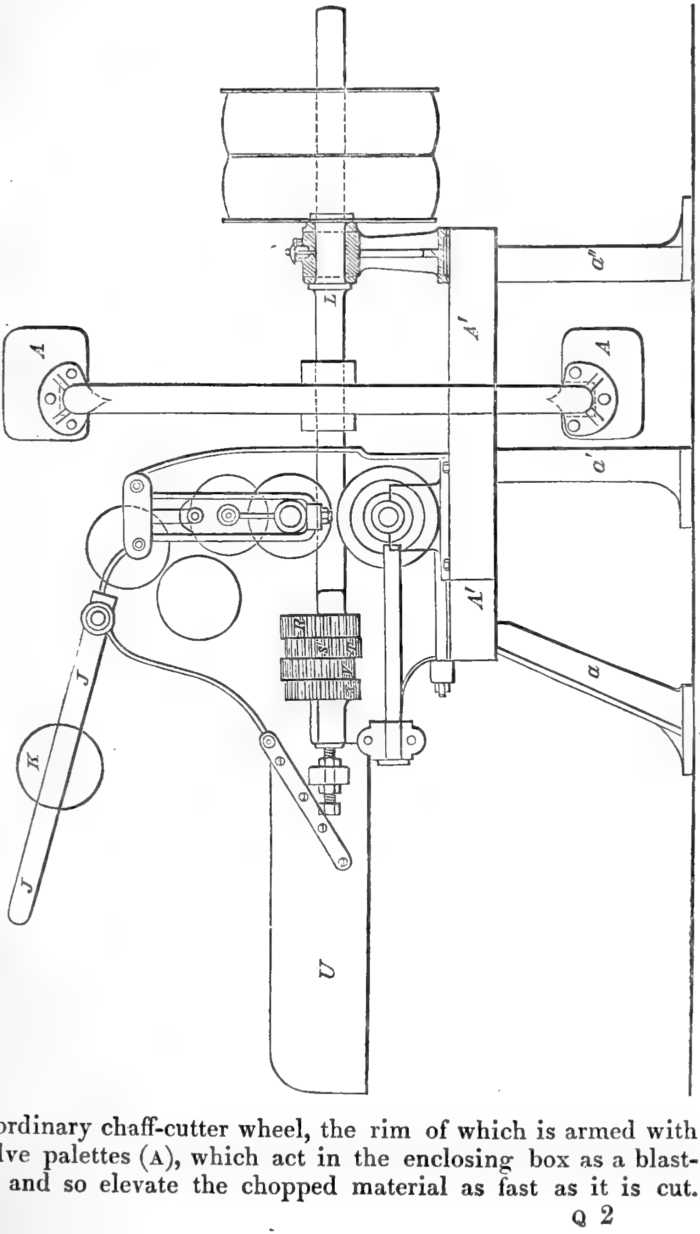


Fig. 18.—*Tranverse Sketch-section of M. Albaret's Elevating Chaff-cutter.*

an ordinary chaff-cutter wheel, the rim of which is armed with twelve palettes (A), which act in the enclosing box as a blast-fan, and so elevate the chopped material as fast as it is cut.

Without entering into any minute mechanical details, it may be sufficient to state that the material to be chopped is placed in an ordinary chaff-cutter feeding-box (U), and is conveyed by means of an endless band to the governing cog-rollers (R, S, T, V, X), and thence to the cutting wheel. The pressure on the material is easily regulated by shifting the balance-weight (K) on the lever (J). The main shaft of the machine is shown at L; it carries two pulleys for the transmission of power from the steam-engine, one being fixed and the other free. The ordinary speed of the machine is 400 revolutions per hour, but it can be driven at 500, and it is capable of cutting 10 tons of maize per hour to the length of about $\frac{3}{4}$ths inch. Notwithstanding this speed, the brake-power is sufficient to enable the machine to be stopped almost instantaneously, and the adjusting arrangements render it capable of cutting efficiently the finest as well as the coarsest materials.

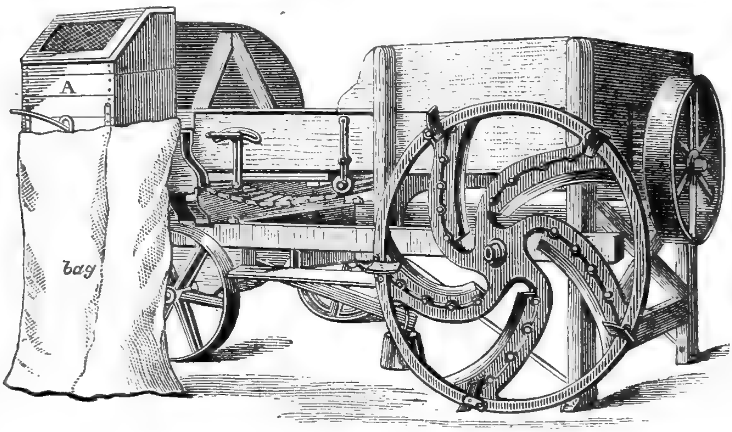
The foregoing description is very inadequate from the point of view of a mechanical engineer, but it may be deemed sufficient for the purposes of the practical farmer, aided as it is by the excellent illustrations which I have given, but which are the merest abstracts of those with which I have been favoured by M. Albaret. I should add one more detail descriptive of the elevating apparatus, that is to say, of the palettes and the shoot, especially with reference to the way in which they are worked. It will be obvious that the material to be chopped is introduced into the containing box, so as to meet the knives of the chaff-cutter, by means of a trough and endless band through an aperture in the centre of one side of it. In the centre of the opposite side and in front of the box are other apertures to admit the air, which becomes the elevating power for the conveyance of the chopped material into the silo or other desired place. The regulation of the strength of this current, without interfering with the speed of the chaff-cutter, is managed by means of a series of small doors along the upper side of the shaft. If all these doors are shut, the current of air obtains its maximum strength in proportion to the speed of the machine; but if it be desired to reduce the vigour with which the chopped material is being delivered, it is only necessary to open one or more of these doors, and thus allow atmospheric air to be admitted into the shoot, so as to diminish the force of the blast. Unfortunately the price of the machine is high, namely 88*l.* (2200 francs), at at the Liancourt Railway Station.

I saw this machine working successfully and smoothly at the farm of my friend, M. Lecouteux, at Cerçay, in the Sologne—a description of whose silos I have given on p. 217—on October 1, 1883; and I am not without hope that

English farmers will be able to see it in operation, as well as the rival machine by Mr. Bust, at the forthcoming Show at Shrewsbury.

2. *Messrs. F. & J. S. Bust, Winterton, Lincolnshire.*—The following description and illustrations have been kindly furnished me by the makers, and I can only regret that I have not had an opportunity of seeing the machine at work:—

Fig. 19.—*General View of Messrs. F. & J. S. Bust's Special "Ensilage" Cutter, with extra Knife-wheel, Bagging apparatus in position, and the Horse shafts removed.*



Special "Ensilage" Cutter.

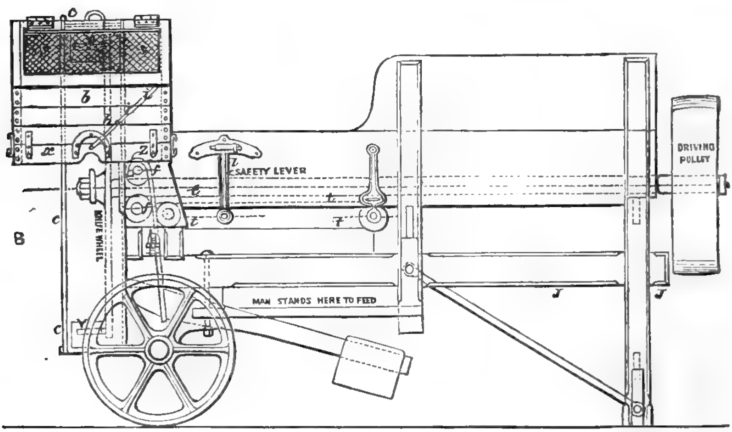
"The above is a most powerful machine, fitted with five knives, and is specially adapted for driving direct from the fly-wheel of a portable engine. If placed near to the "silo," waggons can be driven up alongside, and their load teamed direct on to the cutter feed-board, when it will reduce the product treated into chaff at a tremendous rate, and also throw it into the "silo" as it is cut, thus saving a great amount of labour. The feed rollers are on a principle which entirely prevents choking, however wet or green the fodder may be, and the labour of the feeder is greatly reduced by a travelling web and extra spring roller, which bring the feed forward to the main rollers. Both feed rollers and web can be instantly reversed or stopped by a new *self-releasing* safety lever, which is so arranged that the very fact of a man getting his hands entangled in the feed rollers, would cause him at the same time to bring his weight to bear on the lever and instantly reverse them. This lever acts on a clutch on the fly-wheel shaft, and is quicker in action than it can be on any other, the importance of which will at once be seen, when it is remembered that twenty-five knives pass the feed rollers *per second*, so that a second saved in reversing them might save a man's hand. The main shaft, and both feed rollers, work in *adjustable gun-metal bearings,* provision also being made for taking up any play which the fly-wheel shaft may

get endwise. The gearing is on the most approved and well-tried principle, *malleable iron* being introduced in place of cast iron where it was found liable to breakage. This, together with the improved feed-rollers, has enabled the makers to dispense with the "safety pin" used by most makers, which gives constant trouble and annoyance by shearing off and having to be replaced. Keeping the knives sharp being most important in working a chaff-cutter, it is constructed so that the fly-wheel can be taken off, and another with sharp knives put in its place in about two minutes. The knives also cut over a hardened steel-faced mouthpiece, and claw feet hold the machine securely in position when at work. It is provided with bagging apparatus, and may be used in connection with a steam threshing-machine, driven from a pulley on the drum shaft, when the straw, falling from the machine shakers on to the cutter feed-board, is reduced to short chaff, has the dust blown from it, and is delivered into bags as fast as it is threshed."

The foregoing representations of the end and side elevations of Messrs. Bust's Special "Ensilage" cutter are thus explained by themselves:—

The feed being carried forward by the travelling web, *t*, *t*, *t*, *t*, to the feed rollers, *f*, *f*, is cut into chaff, and elevated by the vanes on the periphery of

Fig. 20.—*Longitudinal Section of Bust's "Ensilage" Cutter.*



the fly-wheel, *v*, *v*, *v*, *v*, *v*, into the bagging apparatus *b*, two bags being hung on at once, one at *x*, another at *z*. When the bag at *x* is full, the shuttle, *i*, *i*, is turned over by the handle *h*, and the bag at *z* is filled whilst *x* is being taken off and another put in its place. For safety, in case of a stone or other hard substance getting into the machine, a strong sheet-iron shield, *g*, is placed in the bagging apparatus, so that the force with which it is thrown off the vanes is broken and directed downwards into the bag. The cover to the fly-wheel case, *c*, *c*, *c*, *c*, is removable for changing the knife-wheels when blunted, and an opening, *n*, *n*, for admitting air and increasing the elevating power of the machine, is covered with wire netting, to prevent any thoughtless person or child putting their hand in; and should the draught be too strong, the door, *d*, *d*, is lowered over the opening, and it is reduced. The lid of the

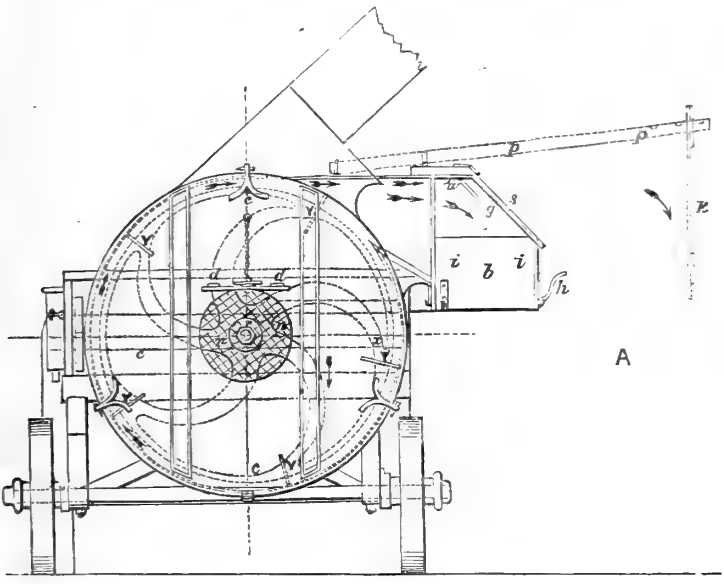
bagging apparatus, *b* at *s*, *s*, is covered with a sieve, to let the air and dust out when cutting hay or straw.

When the silo is sufficiently low and convenient, and it is not required to bag the product, the bagging apparatus *b* is removed, and a pole, *p*, *p*, shown by the dotted lines, is inserted into sockets provided for it, and a hanging board, *k*, is placed on it at any desired distance from the machine to prevent the product being thrown too far. The horse-shafts fix on at J, J.

When it is desired to elevate higher, the bagging apparatus being removed, the mouth of the knife-wheel cover is moved round, and a trunk or spout of the required length attached to it.

This latter arrangement is not included in the price, 35*l*., and 4*l*. 4*s*. for extra knife-wheel, but is charged for extra.

Fig. 21.—*Transverse Section of Bust's "Ensilage" Cutter.*



I have only dwelt sufficiently upon this subject to satisfy those who wish to build or otherwise make silos this summer that the assumed difficulty of filling silos above ground, especially with chopped material, is by no means insuperable. The prize offered by the Royal Agricultural Society, for competition at Shrewsbury, for cutting and elevating machines will probably bring forward some other adaptations of the chaff-cutter, and especially of those appliances which have hitherto been used in connection with it for the purpose of conveying the chopped material into sacks. The report on that competition will doubtless be a safe guide as to the choice of a machine under varying circumstances; and I therefore forbear

from remarking upon the relative features, whether good, bad, or indifferent, of the two machines that I have described and illustrated, feeling that my functions as a reporter have, under the circumstances, been discharged in the foregoing pages, and that anything further from me might tend to mar what ought to be an interesting and instructive competition at Shrewsbury next July.

Summary and Conclusions.

Having given the evidence kindly furnished by more than forty gentlemen who have practised ensilage for a greater or less length of time, both at home and abroad, it remains for me to endeavour to give a judicial summing up, and to indicate in some measure what the verdict of the agricultural public is likely to be on the case as it is now presented to them. For this purpose it will be convenient to commence with the construction of the silo, and to follow with the process of ensilage, the utilisation of the silage, and the capabilities of the system,—in their natural sequence.

Construction of Silos.—Silos are either above ground or below ground, or partly above and partly below, or on a slope. They are either old buildings modified or unmodified, or they are new ones specially constructed. There are many English farms, the steadings of which comprise a large barn, whose occupation is to a great extent *gone.* A large number of silos have been constructed simply by making one or more brick partitions at the end of one of these large barns. This is a simple and inexpensive manner of forming a silo, and has therefore been adopted by a large number of my correspondents. In fact, it may be said that it yields in simplicity and cheapness to no other method except that followed by Mr. Trepplin, which is to turn the whole barn bodily into a silo! This wholesale proceeding, however, is only what the late Mr. Jonas and his Cambridgeshire neighbours have done for years, except that at Kenilworth all the fodder is green, whereas what Mr. Jonas described to me in 1870 * was a mixture of green food (rye, tares, &c.) and oat or wheat chaff. He then said: "Myself and sons have carried out this system of storing old chaff to such an extent, that we are using on our occupation (which consists of 4200 acres of arable land) seven barns which were previously used for storing corn." These converted buildings, or portions of buildings, have in all cases answered the purpose admirably. In the nature of things they are above ground, but in some

* Journ. Roy. Agric. Soc. Second series, vol. vi., Part I., p. 120.

cases—I have never been able to understand why—the floor has been sunk a few feet in that portion of the barn or other structure that has been converted into a silo. Some people have an exaggerated idea of the effect of fermentation upon the bulk of the fodder; and therefore think that, without weighting, it must heave like dough in the process of bread-making; that when weighted it cannot heave upwards, and must therefore bulge laterally; and consequently that a silo above ground ought to be built like a fortress. These terrors are purely imaginary. A nine-inch brick (or concrete) wall carefully lined with cement is sufficient, but fourteen-inch work is better, on account of its superior durability. It is impossible to give any statement of the proper or probable cost of a silo constructed under such circumstances as I have indicated. In every locality, any local builder will very soon give a price for a brick wall of given dimensions. The only necessary extra expenses are (1) for the internal coating of cement, which should be very carefully done, and left as smooth as possible; and (2) for the doorway, which requires special arrangements for closing up before filling, and opening before the commencement of using the silage. It will have been noticed by readers of the foregoing pages that this is sometimes done by brickwork, and sometimes by a double door of wood, with sawdust in the intervening space.

Special constructions, whether wholly above or below ground, or partly above and partly below, are of course more costly, because all four walls, and the roof as well, must be built for the purpose. In England these silos are generally small; but, in a few cases, three or four have been built in a line, and thus a certain economy has been rendered possible. On the whole, however, the cost seems with us to have generally reached 1*l.* per ton of capacity, reckoning the cubic foot to weigh about 50 lbs., or, say, for the sake of round numbers in making mental calculations, half a cwt.—a small exaggeration which goes towards an allowance for the usual unforeseen contingencies. Thus a silo 15 feet long, 12 feet wide, and 10 feet deep, would contain 1800 cubic feet, which at 56 lbs. per cubic foot would be 45 tons. Therefore the cost, roof included, should not exceed 45*l.* But this dictum must be taken subject to many causes of variation:—where wages and materials are both cheap—where, for example, stone can be had for getting it from a quarry close by—where timber or slates can be obtained on the estate—the cost should be very much less. On the other hand, in the suburbs of large towns, where labour and materials are alike very costly, the average price per ton-capacity may often be exceeded. Then the longer the silo the less the cost in proportion, all other things being equal,—a

fact that is specially illustrated by the cost, dimensions, and capacity of M. de Chezelles's silo (see p. 207).

Whether his silo should be above or below ground, or partly above and partly below, or on sloping ground, must be settled by each farmer according to his local circumstances or personal opinions. Still it may be allowable to say that if I wished to build a silo I should choose the side of ever so slight an elevation or depression, and by artificially increasing the elevation, as well as by artificially increasing the depression, I should contrive to be able to put in the fodder at the top and take it out at the bottom. The saving of labour in most cases would very soon repay the small cost of excavating and distributing the additional material.

If the soil is a dead flat, it becomes necessary to choose between the other systems; and then, looking to the advantage of using elevating chaff-cutters such as those I have described, it seems that a silo entirely above ground is the most preferable, except that the roof cannot well be used as a Dutch barn. With a silo entirely below ground, and the roof at a sufficient height, the double purpose is secured at one cost; but against this has to be put the danger of percolation of water, as in the cases of Mr. Hopkins and the Rev. Mr. Ford.

The materials of construction must, or rather ought to, be brick, stone, or concrete, because with the aid of proper mortar and an inside layer of cement they can be made impervious to the air. Nevertheless, attempts to construct silos of wood and iron are not wanting; and the efforts of Mr. Stocks and of my good friend Mr. van der Breggen are described in the foregoing pages. Not having seen any such silos opened, I cannot state of my own knowledge what proportion of the silage is mouldy when it is first exposed to the air; but I have repeatedly seen, and it is admitted on all hands, that the greatest amount of mouldiness in an ordinary silo is found just behind the doorway, and just beneath the covering boards.

A few words as to the roof of the silo are now desirable. It will have been remarked that the only uncovered silo which I have seen was a complete failure; and to save space and discussion I must ask the admission to be made that a silo without a roof, in our climate, is too risky a venture to be practical. Roofs of silos, then, are either movable or fixed. When moveable, the eaves are close to the top of the silo wall, and are generally constructed of boards or of corrugated iron. The Rev. C. H. Ford's roof consists of wooden shutters, those of Mr. Edwards and Mr. Bateman of corrugated iron—the former in flat sheets and the latter in curved ones. These three may be taken as types. But, as a rule, the roofs of silos are

fixed, and are made of any roofing material, whether iron, slate, tiles, Willesden paper, &c. When the silos are either entirely or chiefly below ground, the roofs are often 10 or 12 feet high under the eaves, and the space underneath the roof and above the top of the silo is used for storing hay, straw, &c.

Filling.—After the details of practice already given, it will only be necessary to gather together the threads of the subject, and to show their connection or antagonism. But as "*Filling the Silo*," from the beginning of the process to the end of it, is really a succession of manipulations, and as the net result depends upon the harmonious relation of each one of the series to the rest, the gathering of the threads is not quite so simple as might at first sight appear. Putting aside for the present the purely agricultural questions of mowing and carting, I divide the process of filling as follows: (1) chopping (or leaving unchopped); (2) putting into the silo; (3) treading; (4) covering, and (5) weighting. The consensus of opinion on these several points may be easily stated.

As to *chopping*, it is generally held that, while not absolutely necessary, it is very desirable, because it enables a larger quantity of fodder to be got into a given space, and also because (doubtless in consequence of the greater density of the mass) it facilitates the expulsion of the air from the silo. While agreeing with this general dictum, I must mention at once that my investigations have convinced me that no general rule can be laid down with regard to either chopping, treading, or weighting *per se*. They must be taken as an indivisible *trio*, and even then the prudent farmer will carefully regard the state of his crops before he decides upon his precise mode of action—that is to say, if he wishes to obtain the best results.

If a crop be pitted unchopped, it requires infinitely more treading and weighting than the same crop would require if chopped before pitting. It seems manifest that this stands to reason, because not only does the chopped grass, clover, &c., lie more closely together, and therefore gives less space for the air, which is the greatest enemy to silage; but each cut of the chopper produces a wound from which, under pressure, the plant will bleed, and lose some of its nutritive value.

Treading renders it easy for men and horses or bullocks to make a considerable impression upon grass, clover, tares, &c., after they have been chopped into half-inch lengths; but a mass of whole red clover, tares, or *Trifolium incarnatum*, unless very wet, if pitted whole, would be somewhat elastic to the feet of both bipeds and quadrupeds. As a general rule, therefore, I have noticed that fodder pitted long has gone more rapidly into the later stages of fermentation than that pitted after having been chopped. The only exception that I can recollect was a sample

of second-cut clover, sent me by M. de Chezelles. This had been pitted whole in consequence of an accident to the chaff-cutter; but it was surrounded by a mass of silage that had been chopped before having been pitted. Salt has been very generally mixed with pitted fodder, but it will have been seen that most of my correspondents have come to the conclusion that it is unnecessary, and some even assert that it is deleterious. If it be desired simply to make silage a convenient means of giving salt to live-stock, I do not see much objection to adding a little from time to time as the fodder is pitted, provided always that the green-stuff is dry outside and not too succulent. But if water of any kind or in any combination is in excess, my impression is that the addition of salt will injure the quality of the silage.

Putting in the Silo.—The transfer of the crops from the field into the silo are, as already stated, well-known agricultural operations, except in those cases where the crops have not only to be chopped, but also elevated; that is to say, when the silo is entirely, or to a considerable extent, above ground. There is not the least difficulty when an elevating chaff-cutter is used, but where such a machine is not upon the farm, or cannot be hired, it is usual to fix the chaff-cutter on a level with the upper rim of the silo, and to feed the cutter from a temporary platform placed for the purpose. Considering the importance—always growing—of the system of ensilage, it is to be hoped that means may be devised for converting ordinary chaff-cutters into elevating or non-elevating machines at will, by taking them out of boxes furnished with elevator-spouts, and putting them in again, as may be required; as well as by putting paddles on the rim of the fly-wheel, and taking them off again, as is done with the biting-irons on the wheels of agricultural locomotive engines.

Treading, in itself, is a very important part of the process of filling, and, as a general rule, I may observe that the more complete the treading the less weighting is necessary. I look upon this matter as of cardinal importance, and, although it has been several times mentioned by previous writers as essential, I doubt whether its absolute necessity has hitherto been completely recognized by many persons. When silos are filled, as a rule a certain quantity of material is put into them, and when convenient it is spread about and trodden, especially round the sides, in a more or less perfunctory manner. But this is, in my judgment, by no means sufficient. The treading should go on *pari passu* with the filling, almost inch by inch; and afterwards it will not then be necessary to squeeze the juice out of the fodder by excessive weighting continued over a long period. In the foregoing pages it is recorded what means are adopted by the best "*ensilagers*" (if it is admissible to coin the word) to secure the proper treading of their pitted fodder.

Englishmen employ horses and men, while Frenchmen add draught oxen to their list of treading machines.

Covering is most generally done by means of boards closely fitting together; but there is here also every divergence of practice. Count Roederer and M. de Chezelles both dispense with covering as distinct from weighting, but the stones used by the former are in no sense a cover as a protection from the air, while the earth or sand used by the latter is doubtless very efficient in that respect. At the other end of the scale I may put Mr. Gibson's elaborate arrangement of dowelled boards, the joints covered first by felt and then again by battens; also Lord Middleton's arrangement of a tarpaulin underneath the boards, and Mr. Stobart's use of galvanized iron over the joints. It does not seem to me necessary to take such extraordinary precautions with a view of hermetically sealing the silo. I rather lean to the opinion expressed by Mr. Bateman, that a means of escape for the gaseous products of fermentation is an advantage rather than otherwise. At the same time, I believe that this means of escape of gases upwards should not be such as to expose any considerable mass of the fodder to the atmosphere. The use of bran or sawdust as a covering to the fodder, whether above or beneath the boards, seems, according to my observation, to be useless in the first case, and in the second to have a pernicious influence in rendering sodden the layer of silage immediately beneath it.

Weighting presents similar divergencies of practice. Between 40 lbs. and 2 cwts. per square foot is a great gap, so great indeed that it is almost impossible to account for it except by saying that the lower figure must be too light and the higher much too heavy in all cases, while the diminished range then left may be explained by differences of circumstances. Some of these I will now refer to. The maximum limit of useful pressure has been defined by M. Goffart as just too little to express any of the juices of the plant. This limit can only be determined by experiment and careful observation under different circumstances. But it is not always easy to make these observations, because it is not possible to place a tap at the bottom of every silo. Still, there can be no doubt that the pressure of 1½ cwt. per square foot, applied by Mr. Stobart to a deep mass of cut grass and other green crops, was far in excess of necessity, because of the quantity of liquid expressed from the silage, and drawn out from the silo. As a general rule, I should again say that chopped material requires much less pressure than the same material when unchopped; also that the riper the material, or (to speak more definitely) the less succulent it is, the greater the pressure required. Again, the coarser the plant the greater pressure necessary; for instance, tares or peas would

require more pressure than oats or rye, and these latter more than meadow-grass,—supposing all of them to be cut in about the same state of ripeness. As a general rule, however, tares are cut when much more advanced in growth than grass is when mown, and this fact accounts for a great deal of the difficulty which has been experienced in attempts to preserve tares by ensilage. I have already noticed the influence of the treading upon the subsequent weighting.

Having thus indicated what I conceive to be some of the main principles which regulate the amount of pressure required, I must now glance at the best means of applying it. Iron weights, steel ingots, and concrete blocks are excellent materials for the purpose, but they cost a considerable sum of money; and although it may be true that iron and steel can be sold in the market at any time for nearly their cost price, yet while they are being used the capital thus represented is locked up; and one may doubt whether tenant-farmers, as a rule, are in a position to invest money in such a way. Mechanical means of pressure I have described, and every one can judge for himself as to their relative merits. Speaking generally, they seem to me, in their present condition, rather costly, and in some cases a little complicated. Still, I expect that in the future they will be both simplified and cheapened. The farmer's choice is therefore, in my view, at present almost restricted to local materials; and the only danger arising from their use is that his men will throw them on the silo "higgledy-piggledy," without any regard for the equal distribution of the pressure. I would on this ground recommend that, whatever the material employed—whether sand, mould, stones, "runners," slag, &c.—the pieces should be put into some kind of package. Mr. Bateman uses old oyster-barrels; the Duke of Sutherland uses bags filled with sand (in fact, old guano bags are in frequent use), others use boxes, and so forth. I have frequently referred to the practice of M. de Chezelles, who simply covers his fodder with a layer of sand or earth about a foot in thickness; it seems to me that this is as good a means of weighting as any other, if access can easily be obtained to the top of the silo; but I should prefer boards being placed under the weighting material, for the sake of cleanliness, and thus to avoid waste.

The total cost per acre of all the operations connected with the filling of the silo varies with the distance of the field from the silo, the weight of the crop, whether it is put in chopped or whole, and the rate of wages in the locality; but it appears from the details already given that about 20*s.* to 25*s.* per acre is an average cost, and that this means generally a little more or less than 5*s.* per ton of silage.

As to the crops most suitable for ensilage, probably a tolerably

exact idea will have already been gained. No doubt green maize is, *par excellence*, the crop which is at the same time the best suited by its composition for preservation by ensilage, and the least capable of being usefully preserved in any other manner. But as it can be grown profitably in only a comparatively small corner of England, it has relatively little interest for the Btitish farmer. Grasses and clovers, as well as green oats and rye, can be perfectly preserved, especially if cut a little before the time at which they are at their best for being harvested in a dry state. Pulse of all kinds, but especially tares and peas, are also capable of preservation in silos, but their treatment requires more care, as I have already mentioned.

Buckwheat is a crop which has been successfully ensilaged on the rare occasions that have come before me, while on the other hand I have not yet met with an instance of prickly comfrey making good silage.

Utilisation of Silage.—Most agriculturists who have tried the system of ensilage use the contents of their silos by cutting them vertically as they would hay in a stack. A few adopt the opposite plan of cutting laterally ; but on the whole the balance of advantages appears to be largely in favour of the more general plan. In England, again, where the system is still more or less in an experimental stage, the general plan at present is to substitute silage for all other bulky food for stock. In France, however, it is customary to mix the silage with an equal or even a much larger quantity of other material, such as chopped straw, beetroot-pulp, hay, roots, &c. My impression is that the French system, which is founded on a longer experience than we possess, is the more rational, and, indeed, the more economical. By reference to Mr. Hunting's account of his experience it will be seen how a trained veterinary surgeon was surprised at the action of silage upon the alimentary canal of his cattle. It made them costive. This is not to be wondered at, especially if the silage was not absolutely undergoing acetic fermentation ; that is to say, if it had not yet become converted into *sauer-kraut* or pickles. It is an everyday experience that brandy is given to human beings in cases of diarrhœa with a view of checking it ; and therefore a large dose of 50 to 80 lbs. or more of a highly fermented mass is likely to have a similar effect upon the animal organism. But a smaller quantity mixed with a due proportion of other bulky food seems to stimulate the digestive organs, and to enable the animal to assimilate more food than it could under other circumstances—the nearest approach to its action being probably that of a fermented mixture of pulped roots and chopped straw. Then it should also be noted that the use of silage does not in any

sense affect the desirability of giving the usual rations of concentrated or "artificial" foods, either to milch cows or to feeding beasts or sheep.

A most important point in reference to the use of silage as food for in-calf cows has been frequently the subject of discussion with dairy-farmers, in consequence of an assumed analogy between pitted fodder and brewers' grains, owing, I presume, to both being more or less fermented foods. It is generally accepted as a fact that milch cows cannot be fed to a large extent upon brewers' grains without their soundness for breeding purposes being impaired; and this has suggested the very serious question whether silage would have a similar effect upon the breeding powers of cows fed upon it. In England, our experience has hitherto been of so short a duration that it is impossible to speak positively on the subject; but I may say that I have never heard such a complaint made against the use of silage on the Continent.* Still, it must be admitted that on these and some other points we have a great deal yet to learn; and although Mr. Hunting's experiment with his heifers has been encouraging, I should recommend the use of silage as food for breeding animals to be conducted with caution, and especially that the silage should be mixed with at least an equal quantity of unfermented bulky food, such as hay, chopped straw, &c.

If my correspondents are unanimous at all, it is in testifying that cattle are ravenously fond of pitted fodder. Whether it be good or only indifferent it makes apparently but very little difference to the cattle; sheep seem to be rather more fastidious; and, in the case of horses, their likes and dislikes appear to be more personal than generic. The experiments which have already been made as to the nutritive value of silage are comparatively few, and very few of these are comparative; but enough seems to be known to warrant the prevailing belief that well-made silage is at least as valuable for feeding purposes as the best hay. Probably it would not be going beyond the facts, notwithstanding some adverse reports, to state that in the case of milch-cows silage generally has a greater cream-producing value than hay. Exact experiments are still wanting to enable one to judge of the effect of this feeding material upon butter and cheese, but the more salient elements of the problem have been clearly pointed out by some of my correspondents.

Changes which Fodder undergoes in the Silo.—I am by no means competent to write a treatise on the chemistry of ensilage, and therefore I do not propose to attempt to do it. My

* The experiences of Mr. Bateman with ewes, of Mr. Gibson with cows, and of the Vicomte de Chezelles with both cows and ewes tend to show that the judicious use of silage as food does not interfere with the breeding powers (pp. 160, 182, and 209.)

eminent colleague, Dr. Voelcker, would have written a separate paper on this subject in elucidation of the facts contained in this Report if his health had permitted. All I can do, therefore, is to give a very broad statement of the questions involved, as I understand them, subject to Dr. Voelcker's correction on a future occasion. The chemical changes which fodder undergoes in silos have not yet been thoroughly investigated, but they may be indicated by one word—fermentation. The theory of fermentation, also, is by no means the least debateable in the range of chemical science; but it is generally understood to practically resolve itself into the conversion of sugar, gum, starch, or allied compounds into simpler bodies, such as carbonic-acid gas, lactic acid, alcohol, acetic acid, &c.

The various kinds of fermentation have been shown to be due to the action of innumerable minute microscopic organisms, the germs of which are freely distributed in the atmosphere. These organisms live upon fermentable substances, and transform them into simpler compounds, much as the animal transforms the food it consumes and the air it breathes into carbonic acid, urea, and other bodies. Each special kind of fermentation is said to be produced by a more or less distinct class of organism, and the precise nature of the fermentation set up may therefore be inferred to depend upon what particular species of organism is most favoured by the nature of the fermentable substance and the conditions in which it is placed. In most cases the changes involved in fermentation take place only in the presence of some nitrogenous substance, which, under the vital action of the organisms, becomes partly converted into a chemical "ferment," and in the presence of a sufficient quantity of water. But the special nature of the fermentation set up depends upon a multitude of circumstances; and in the case of fodder in silos probably to some extent upon the proportion of sugar contained in the plant. For example, green maize generally contains a large quantity of sugar in comparison with other fodder-crops, and is said to undergo lactic fermentation. Without entering into details, this means that it becomes a kind of *sauer-kraut* or pickle, without passing through any intermediate stage of fermentation, and therefore with the minimum amount of loss of nutritive material.

But it is rarely the case that our English fodder crops contain a sufficiently large proportion of sugar to enter largely into lactic fermentation. Therefore, as soon as fermentation begins, alcohol is formed. This means a certain loss of nutritive matter, which is carried still further by the almost immediate conversion of the alcohol into aldehyd—a very evanescent substance which, with the fodder itself, produces the smell so

frequently described as like burnt sugar, Cavendish tobacco, &c. &c. It is somewhat remarkable that very few samples of silage have yielded to the analyst more than traces of alcohol, although by their smell one would think them saturated with it. This is due to the powerful odour of the aldehyd, which may, in common language, be regarded as partially burnt alcohol. If the air has not been properly expelled from the silo, or if the fodder has been pitted very wet, the aldehyd rapidly becomes converted into acetic acid, otherwise vinegar. And so by this roundabout process we get a *sauer-kraut*, or pickle, by a much more destructive and therefore expensive system than by means of the direct lactic fermentation.*

The farmer will doubtless want to know how to control these various changes, and which is the best condition for his silage to remain in. As we have not the summer heat of the grape-growing districts of France, we cannot hope to grow maize, and other fodder crops containing a large percentage of sugar, over the greater part of England; and this consideration has retarded the use of ensilage for crops having a small percentage of sugar, not only in England, but also in France and America. It is only of late years that these crops have been preserved by ensilage. In the case of our own fodder crops, the evidence given in the foregoing pages tends to show that crops cut before they begin to get woody (in other words, while they are still full of sap), pitted after having been chopped, then carefully trodden layer by layer, then covered with boards, and moderately weighted, stand the best chance of not going much beyond the alcoholic fermentation. On the other hand, crops put in unchopped, dripping with wet, imperfectly trodden, and no matter how heavily weighted, will rapidly go through all the processes, and even beyond those I have spoken of, namely, into the putrefactive stage.

Speaking from experience gained by the examination of a large number of samples of silage, the facts attending which I have given in the preceding pages, I may state broadly with regard to their keeping qualities, that the *sauer-kraut*, or pickle stage, will keep the longest, and the almost non-fermented samples the shortest time without becoming mouldy.† Samples emitting the characteristic smell of aldehyd will keep good for some considerable time if they are dry, but rapidly go bad if they are wet.‡ Mr. Garrett Taylor's sewage-grass silage is an

* See Mr. Smetham's note on p. 383 for an explanation of the changes which took place in the fodder pitted in Lord Egerton's silo.

† Compare Heer van der Breggen's statement on p. 223.

‡ The smell of aldehyd often remains long after the substance has been converted into acetic acid. In fact, aldehyd has never, I believe, been detected in silage, on account of the transient nature of its existence.

example of the former, and Mr. Trepplin's numerous samples of silage of different crops of the latter. I do not know that it is a great object, except on large sewage-farms, that silage should keep good after exposure to the air for more than a week or two. If the fodder be cut in slices not too thick for ordinary requirements, the new face is not exposed long enough for any considerable deterioration to take place. Therefore the main point for the farmer is to obtain his silage only so much fermented as will enable him to use it to the best advantage, and this I conceive to be the alcoholic stage.

Hitherto I have spoken only of the effect of fermentation in breaking up the starch, gum, &c., into alcohol and other products; but chemists seem to believe that the nitrogenous materials which act as a ferment are also themselves more or less decomposed. It is considered that the value of these nitrogenous materials as flesh-formers is thereby impaired; but in the present state of the question it is unnecessary to discuss it further in this Report.

The effect of the fermentation on the woody fibre is, however, better understood, and is, moreover, of greater practical importance. Dr. Voelcker showed, in the volume of this 'Journal' for 1871,* that the effect of fermentation on the straw-chaff preserved by Mr. Jonas's method was to convert a large proportion of the indigestible woody fibre into digestible material. On this point he observed: "In the cases before us, it will be seen that, of the total amount of vegetable fibre present in the fermented wheat-chaff, 45¾ per cent. were rendered soluble by the treatment described, and 34½ per cent. (in round numbers) left behind as indigestible woody fibre, whilst the 73½ per cent. of vegetable fibre present in common wheat-straw chaff were resolved . . . into 19½ per cent. only of digestible, and into 54 per cent. of indigestible, woody fibre. In other words, the same treatment rendered soluble 50·85 per cent. of the vegetable fibre of the fermented prepared chaff, and only 26·38 per cent. of the fibre of common wheat-straw."

The construction of a Dr. and Cr. account as between the loss of feeding material occasioned by the conversion of carbohydrates into alcohol and acetic acid on the one hand, and the gain of feeding material by the conversion of indigestible into digestible woody fibre on the other, is a question for the chemical accountant, and no doubt such a balance-sheet will be shortly forthcoming.† To the farmer, however, the "proof of the pudding is in the eating;" and whatever may be the result of

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* 'On the best mode of preparing Straw-chaff for Feeding Purposes.' Second Series, vol. vii., p. 85.

† *Vide* remarks by Mr. Betley on p. 157.

future experiments, it will have been seen that my correspondents are now generally prone to attribute at least as great a feeding value to silage as to hay, and further to credit Ensilage with "Safety" and to debit Hay-making with "Risk."

The functions of Ensilage in the Economy of the Farm.—Most of the advances which are made in the arts and sciences, as well as in our everyday practices, we owe to enthusiasts; and ensilage, especially in England, is another illustration of this historic and well-known fact. It is perhaps as well that British phlegm should be sufficiently powerful, and sufficiently distributed amongst English agriculturists, to induce them to question closely many of the statements that have been made by the more enthusiastic advocates of ensilage. I cannot believe, what I have heard asserted, that 1 ton of grass made into silage is worth several times as much as if it were made into hay. I can believe, however, that the feeding value of silage from a given weight of grass may be sometimes greater than that from the same weight of precisely similar grass if made into hay under even favourable circumstances. This is because, in my view, the haymaking process tends to render a portion of the woody fibre of the grass harder and more indigestible than it was before, while the process of ensilage tends to render it mechanically softer and chemically more digestible.

But does it follow that ensilage is to supplant hay-making? To answer this question even approximately is rather difficult, because there is no pursuit with so kaleidoscopic a character as farming. It may also be said of farms, as it has been said of faces, that no two are exactly alike. However, it may be allowable to give an imaginary example, if only to enable each reader to make his own additions to, and subtractions from, my illustration, so as to fit it to his own circumstances in different seasons, and with altering markets. For this purpose I will suppose an ordinary 400 acre farm, with no more than one-fourth of its area permanent pasture. The complete substitution of ensilage for hay-making would require silo accommodation for the permanent grass off about, say, 50 acres, as well as for the aftermath at least of the seed-course, and probably tares, &c., besides. Where there is no breeding flock, and also where breeding cattle are not kept, the demand for silo accommodation would be even greater, because the speciality would be feeding beasts in the winter. However, 50 acres of grass might be supposed to yield in the course of the year 6 tons of green fodder, say a total of 300 tons; the aftermath of the 75 acres of seeds might also be roughly estimated at not less than 200 tons, say upwards of 500 tons of silo-capacity required. The provision of silos to this extent would require a capital expenditure of certainly not

less than 1*l.* per acre on the whole acreage of the farm, and probably 25 per cent. more; but of course, as already suggested, on many farms more grass would be fed, as well as a large proportion if not all of the aftermath, and in such cases the cost of silo accommodation would be proportionately lessened.

It will be gathered, therefore, that I regard the system of ensilage as a valuable addition to the resources of the English farmer, but not as a complete substitute for the old haymaking process. In different districts there will doubtless soon be annual uses made of the system with as much regularity as wheat is now sown, and some at least of these uses can already be indicated. Take, for instance, the North of England, where autumn rains, and even early winter snows, render it almost impossible that clover aftermath can be made into hay for winter use; the process of ensilage enables it to be preserved almost without considering the state of the weather. On clay-land farms, where turnips are notoriously difficult and expensive to grow, but where nevertheless some succulent winter food must be obtained, ensilage supplies the solution of the difficulty. On such lands, tares can be grown profitably; and *with care*, but not without, they can be preserved for winter use as an excellent and very nourishing substitute for turnips. Again, take a suburban dairy-farm, practically all grass, and up to the present time dependent upon purchased mangolds, cabbages, and other succulent food which will enable the cows to be kept profitably through the winter; now the system of ensilage enables the suburban farmer to make a portion of his grass into a succulent and stimulating food, yielding more milk and costing far less money than the roots which he was formerly obliged to purchase. Lastly, I will indicate an arable farm in the southern and south-eastern counties, where feeding a large head of stock is the great object. On such a farm, immediately after harvest, a portion of the stubbles can be sown with rye or winter vetches, reaped in April or May, and preserved in silos; then a crop of roots, tares, or even maize can be sown, the roots to be used as hitherto during the winter, and the other green crops after having been pitted in the autumn. In all these cases, it seems to me that the undoubted loss of nutritive matter, which is one result of the processes of fermentation, is of very small importance in comparison with the practical advantages of ensilage, and the element of security which it contains.

Readers of the foregoing Report will doubtless have noticed that in some important respects I do not follow some previous writers on the *modus operandi* of ensilage. While having drawn my conclusions from the evidence furnished by practical men, supplemented by my own observations, I am free to admit

that there is a considerable scope for the possibility of error; and therefore I conclude this Report with the following quotation from Professor Johnston's previously cited article, "On the Feeding values of the Natural and Artificial Grasses in different States of Dryness," published in the 'Transactions of the Highland and Agricultural Society of Scotland for 1843' (p. 57):—

"Much knowledge remains yet to be acquired in reference to the most economical mode of using green crops as food for cattle. It is true that there exists much valuable information *floating* among intelligent practical men, but when the unprejudiced inquirer begins to collect, with the view of *fixing* this floating knowledge, he meets with opinions so contradictory, even from men of equal intelligence and skill, that he must be well acquainted with those causes which affect the results of agricultural operations in different localities before he can hope to approach the truth, or to extract anything like general principles from the testimony of practical men alone. The opinions of practical agriculturists are derived in general from their own experience, and from that of their neighbours, in a limited district only. In distant parts of the country, we know that these opinions are often quite opposed to each other; yet the phenomena from which the cultivators of each province have deduced their opposite opinions, are the natural results of the same general laws. It is these laws which the philosophical agriculturist seeks to discover."

V.—*On the Domestic Veterinary Treatment of the Animals of the Farm.* By Professor G. T. Brown, of the Agricultural Department of the Privy Council.

It would be quite easy to prove by reference to the facts of physiology, that the animal organism is a delicate and complicated piece of mechanism, and that the attempt to rectify any errors in its structure or functions is likely to result in disaster, unless the effort is made by one who is familiar with all the details of the machinery. This line of argument is commonly adopted, but it makes no impression on those to whom it is addressed; and the savants who employ it are so far inconsistent advocates of their own principles, that they publish works on the diseases of stock, and the methods of cure, and dedicate their books to the agriculturists of the country. The fact is that, whether recognised by scientific men or not, domestic medicine, both in application to men and the lower animals, is an institution which cannot be abolished, and it

may therefore be worth while to offer some suggestions, with the view of placing it in its proper position so far as it relates to the veterinary treatment of farm-stock.

First, it should be clearly understood that domestic medicine is restricted to the use of simple remedies. All kinds of advertised nostrums should be avoided as the essence of quackery, and no medicine the nature of which is not known should be administered under any circumstances by the tyro.

Secondly, it should be held as a maxim of undoubted truth that the animal organism possesses a wonderful power of reparation.

Thirdly, it should never be forgotten that while powerful chemical agents may interfere with the natural progress of a disease towards recovery, it may often be doubted if medical aid can materially assist it. Circumstances occur in which it is a question what ought to be done in the treatment of a certain phase of a disease; and if the question cannot be answered without hesitation, the most experienced doctor would incline towards that system which a great medical authority pleasantly described as "the art of amusing the patient while nature cured the disease."

Lastly, in all cases of doubt, and therefore of difficulty, it is desirable to seek the best veterinary aid which can be procured. The Royal Agricultural Society, in recognition of this view, has from time to time endeavoured to bring its members into closer relation with those of the veterinary profession, and has always been ready to use its widely extending influence, and its funds, in furtherance of this object; not always, however, with the success which the effort merited.

With the view of enabling members of the Society to avail themselves of veterinary assistance at a moderate and fixed cost, it was arranged some time ago that veterinary surgeons of repute should be appointed in certain districts, on condition that they should afford their services for the remuneration which was fixed by the Society, and should also report to the Secretary the results of any inquiries which they were called upon to make.

Up to the present time the appointment of district veterinary surgeons has not, so far as is known, been attended with the benefits which were anticipated; nevertheless the scheme contains the nucleus of a system which is capable of extensive and useful development. Stock-keepers would consult their own interests if they placed their animals in the charge of competent veterinary surgeons whose duty it would be to inspect them regularly, and advise in reference to their management, chiefly with regard to preservation from disease. If by any means the general adoption of this system could be secured,

veterinary surgeons instead of collecting together in large towns, would find it convenient to reside in country districts, which are now so badly supplied that the farmer, when he requires veterinary aid, is often obliged to send a messenger several miles, with the risk of finding the veterinary surgeon absent, and the certainty of losing time, which in cases of serious illness is all important.

Under the contract system the expense of regular veterinary attendance would not be great, and the plan which the Society has adopted of appointing veterinary surgeons in certain centres might easily be extended, so as to provide sufficient means for carrying all the necessary details of the scheme into effect, and, under such conditions, it may be presumed that the extensive damage which is annually inflicted on the live-stock of the country by the ravages of various diseases would be materially mitigated. The veterinary expert would be aware of the circumstances under which all the animals in his district were living, would recognize the presence of existing and suspect probable causes of disease, and take measures to moderate their influence. In many, perhaps the majority of cases, he might be able to counteract it entirely. Remedies which might be required in emergencies would be supplied to the farmer, with proper directions for using them, in the absence of the veterinary surgeon; and when he arrived, he would have the manifest advantage of knowing exactly what medicines had been given, instead of having to guess at the character of some nostrum which the stockowner had administered, for no better reason than is afforded by the advertisement which announces it to be an infallible cure for all diseases to which the animals of the farm are subject.

As it is vain to hope that farmers in general will avail themselves of the constant aid of the veterinary surgeon, it may not be out of place to offer some advice on the subject of the treatment of farm stock when veterinary assistance is not within reach, or the illness is deemed to be so slight in character as not to require any professional skill for its cure. In either case it is quite certain that the owner of the animals or his servant will do something; and it is a primary necessity that the remedial measures which may be employed shall not be capable of adding to the mischief, instead of repairing it.

One serious obstacle will present itself to the amateur in his attempt to select appropriate remedies. Correct interpretation of the symptoms which are indicative of a departure from the healthy state is often difficult to an experienced observer; to the tyro it is, in many cases, an impossibility; but some of the more common ailments of the animals of the farm are distinguished by signs of such a definite character, that the difficulty

does not arise, and it is with reference to these common disorders that advice as to treatment is most needed.

Wounds and other Injuries.—Accidents in the stable and in the field are sufficiently common among the animals of the farm, to render it necessary for the farmer to be prepared to deal with injuries of a trifling kind not requiring any surgical operation. Wounds, bruises, and sprains are the principal forms of injuries which are likely to be met with, and although the treatment which each form demands will be modified by various circumstances, there are certain general principles which must always guide the application of remedial measures.

Wounds.—It may be accepted as a fact beyond question that wounds heal naturally in a healthy state of the system, and the process cannot be accelerated, although it may easily be retarded. The unhealthy state which wounds sometimes assume is generally due to the introduction of septic germs from without; and the first essentials of treatment are to remove all dirt and foreign matter from the injured parts, and to protect them from infection by excluding the air and everything else, by the agency of an antiseptic barrier of medicated cotton or gauze. All ointments, tinctures, lotions, or plasters may be discarded with advantage from the list of domestic appliances for the cure of wounds, and the amateur surgeon may content himself with the simple expedient of adjusting the edges of the wound as perfectly as his skill will enable him to do; and then applying a little carbolised cotton-wool, to be kept in its place by means of a bandage of carbolised gauze. Under this method of treatment healing takes place without any inflammation, or the occurrence of discharge, unless the adjacent parts have been much damaged by the force which caused the injury.

Injuries to the foot are commonly the cause of lameness, which is in many cases well marked, without the cause being apparent. As a general rule, it is safe to ascribe all lameness to injury or disease of the foot until the contrary is proved. Professor Coleman is credited with the utterance of a dictum, that if the cause of a horse's lameness could be shown to be centred in the animal's head, it is nevertheless necessary to seek for it in the foot; and the frequent occurrence of wounds and bruises in this organ from shoeing, and also from contact with hard substances on roads, sufficiently justifies the learned Professor's maxim.

In every case of lameness, especially when the fore-limbs are affected, the shoe should be removed, and the foot searched by paring, and by pressing with the pincers, until it is quite clear from the absence of pain on pressure that no injury has been inflicted. If, as commonly happens, an abscess is detected, whether it arises from a prick by a badly-driven nail in

shoeing, or from a bruise inflicted by a stone in the road, the treatment will be the same. The matter must be allowed free exit, without the unnecessary removal of the substance of the hoof: the foot should then be soaked in warm water; a little tar on a piece of tow should be placed on the wound, and after the shoe has been lightly nailed on, a stopping of tar and tow should be applied to the bottom of the foot, and retained by means of splints. An undetected abscess in the foot is a serious affair. The imprisoned matter generally finds its way to the coronet, and extensive disease of the foot-structures is a common consequence.

Cracked Heels, Mud Fever, and Grease.—No more annoying diseases exist in the list of maladies to which animals are liable than cracked or chapped heels, mud fever, and that peculiar affection of the skin of the heels and fetlock joints which, from the greasy nature of the discharge which issues from the surface, is commonly designated "grease."

Cracked Heels arise from exposure to wet and cold, and it may be concluded that the mechanical effects of dirt and grit are contributory to the general result.

Mud Fever may be looked upon as an extension of the state of irritation which, in its more limited form, is the beginning of chapped heels.

Grease, at least in its early stage, is the outcome of the influence of the causes referred to. In the more advanced condition the disease assumes a malignant character which defies the skill of the experienced veterinarian.

In the early stages of "grease" an antiseptic and astringent lotion may be used with advantage, and the well-known preparation, Sir William Burnett's Disinfecting Fluid (chloride of zinc) is very useful for this purpose; and indeed in all cases of slight abrasions of the skin, sore shoulders, wrung withers, and also in all instances of wounds accompanied with fetid discharge. A lotion of convenient strength for general use is made by adding 1 pint of the fluid to 50 parts of water.

In the undiluted form, the disinfecting fluid is a caustic and poison; care must therefore be taken to keep it in a secure place.

The several diseases of the skin of the legs above named may be to a great extent prevented by the adoption of a plan of management which is perfectly simple, and at the same time effectual, as the experience of many years has shown. Ordinarily, horses on returning from work have their legs, and probably a portion of their bodies, scraped and washed. The subsequent process of drying, if attempted at all, is imperfectly performed, and the surface of the skin is left moist and cold, until the natural heat of the body causes the evaporation of the moisture

at the cost of a large expenditure of heat. Considerable disturbance of the function of the skin may be traced to the effects of the evaporation. The occurrence of mud fever, and the different forms of disease which have been mentioned, is thus explained.

A happy inspiration induced some one to adopt the expedient of leaving the wet mud on the legs of the horse returned from work, to form a protective covering while the drying process was proceeding. On the following morning the dried mud was brushed off without difficulty, and forthwith "chapped heels," "mud fever," and "grease," ceased to appear in the stables where this plan was adopted.

Further experience has shown that if mud can be washed off at once by driving the animal into a pond, and then continuing the journey home, no harm results. The mischief is done by the washing, especially if warm water is used, when the animal has arrived home, and is to remain stationary for the night in the stable.

In the case of hunters, it is considered advisable to wrap the muddy legs in flannel bandages; haybands will form an effective substitute in the case of the farm-horse, but the essential thing is to refrain from any washing or attempt to remove the mud until it is dry enough to be brushed off.

When cracked heels or mud fever have actually occurred, a very useful application for the relief of irritation will be found in a mixture of vaseline, 8 parts, with trisnitrate of bismuth, or white lead, or oxide of zinc, 1 part, which may be kept ready for use, and applied once or twice a day.

Bruises, whether associated with wounds or not, generally induce a certain degree of inflammation, with its necessary accompaniments of heat, pain, and swelling. Under these conditions, hot or cold applications are in favour with different people, irrespectively of the actual state of the damaged parts, which may render one of the remedies highly injurious, while the other would prove especially beneficial.

Cold lotions are most effective in cases of recent injury, before swelling has commenced; and to obtain the full benefit of the remedy its application should be continuous until the desired effect has been produced. A temporary cessation of the treatment would permit the occurrence of vascular reaction, and all the preventive effects of the remedy would be lost.

Hot fomentations are absolutely necessary when inflammation has commenced. The object then is to soften the injured parts and promote exudation, which will relieve the overcharged vessels. Cold applications in the active inflammatory stage inflict unnecessary pain, and retard rather than assist the cure.

Wounds which are associated with bruises do not heal

without the formation of discharges. Still the antiseptic treatment, by the aid of a solution of carbolic acid, 1 part to 100 of water, with carbolised cotton and gauze, is most effective.

Sprains.—Muscles, ligaments, and tendons, are sometimes extended beyond the limits of their elasticity, owing to sudden and violent movements of the animal, and the result is inflammation, with swelling and pain. Excessive strain may cause rupture of some of the minute fibres of these structures, and then perfect recovery is rare.

The immediate effects of sprain are swelling, heat, and lameness, which is the expression of the pain incurred in moving the injured part; the remote effects are, in many instances, permanent enlargement of the parts, and weakness of the injured muscle, tendon, or ligament, which renders it susceptible to a recurrence of the injury, and to some extent impairs the animal's usefulness. For these results of sprain powerful counter-irritants are deemed necessary, at least they are usually employed; but experience has shown that equally good effects may be produced by the persistent use of cold water, with perfect rest for a considerable period.

When blistering is required, the ointment of the biniodide of mercury is most effective. Firing and setoning are operations requiring surgical skill, and it is not expected that the farmer will attempt them. Indeed, the reckless adoption of these severe measures is to be deprecated.

Common Diseases of the Digestive Organs.—Animals of different classes in domestication are somewhat differently placed in regard to their liability to disease. Horses, for instance, and breeding animals generally, are fed with the sole object of keeping them in health, or in working condition; whereas cattle, sheep, and swine, which are intended for the butcher, are supplied with as much provender as can be utilised economically by the organism, the object being to fatten them as quickly as possible, without regard to the remote effects of this "forcing system" on the health of the animals. A natural result of this artificial method of feeding is the production of certain diseased states of the digestive organs, from which working animals are comparatively exempt. On the other hand, the working animal is more frequently subjected to climatic influences, and to alternations of exertion, sometimes of a violent kind, with complete inaction in the stable, conditions which render him liable to diseases of the respiratory system in particular.

Horses suffer at certain times from a form of indigestion which is in horse language expressed in the significant term, "loss of condition." The animal is disinclined for food, or eats everything ravenously; the skin is harsh and unthrifty,

adhering to the tissues beneath, constituting the state known as "hide-bound." The legs swell after a short time of rest in the stable; and the swelling subsides after exercise, to return when the animal is again allowed to rest; and whether the appetite remains or altogether fails, the body becomes emaciated. Eruptions on the skin, attended with extreme itching, "cracked heels," and grease, are complaints which frequently occur when an animal is in bad condition, and add to the difficulty of effecting a cure.

Alterative treatment, as it is called, is required in cases of "bad condition," with or without complications, and the term "alterative" may be understood to mean alteration of the whole system of feeding and management, as complete as it is possible to effect.

Medicines do not play a very important part in the "alterative" system, but there is no objection to the daily administration of a table-spoonful of a mixture of sulphur and nitre in equal parts in the food. Rock salt should always be placed in the animal's reach, and the food should be varied as much as possible. In many cases a total change from vegetable to animal diet is most effective. Milk with well-beaten eggs added may be given with the best results to animals in a state of extreme debility and emaciation, and it may be noted that wonderful effects have been produced by feeding animals on soup made by boiling pieces of any kind of meat. The liquor, when cold and freed from fat, may be used to make a mash by mixing it with bran. At first the animal's taste may be cultivated by putting small portions of the mixture into the mouth, but in a short time animals become exceedingly fond of the new diet, and thrive upon it in a remarkable manner.

Colic or Gripes.—Farm-horses are particularly liable to attacks of spasmodic colic. Indeed,—owing most likely to the character of their work, which necessitates abstinence of some hours' duration, often in hot weather, from water or food, and consequently leads to the rapid consumption of both on the return to the stable,—the animals suffer more frequently from colic than from any other disease of the digestive organs. Exposure to wet and cold, drinking freely of cold water, or eating ravenously of coarse food, are the chief causes of the attack.

Symptoms of colic are easily recognized, and the attendant does not often fail to form a correct opinion. The pain, which is due to spasmodic contraction of the muscular tissue of the intestines, is acute, and the horse expresses his suffering by violent movements, rolling on the ground, kicking at the belly, looking round at his flanks, whisking the tail, and moving quickly from side to side in his stall. The countenance expresses

excitement, the eye is bright, and the pulse full and quick during the continuance of the pain, which ceases from time to time, and recurs after intervals of ease. This peculiarity of the disease is a distinctive feature which should always be noted, because colic is sometimes confounded with the more serious inflammation of the intestines (enteritis) from which it is most essential it should be clearly distinguished. For this purpose it is enough for the farmer to know that in inflammation the aspect is dull, and the pain less violent; and is continuous, instead of intermittent, in its expression.

Treatment of colic is generally successful; but fatal cases do occur, and no time should be lost in applying remedies. A very useful and harmless mixture is to be prepared by combining equal parts of sweet spirit of nitre and laudanum; of this mixture three tablespoons should be given at once in about half a pint of water, or, if the animal has eaten too freely of coarse food, in a pint of linseed-oil. Immediately after the draught has been given, the horse should be walked about for half an hour; and if at the termination of the exercise the pain continues, a second dose of the colic mixture in water may be given; and should another half hour pass without relief, it is time to summon the veterinary surgeon, and, pending his arrival, the belly should be fomented with water as hot as the hands of the men engaged can bear.

Hoven.—Among cattle and sheep, distension of the first compartment of the stomach with gas from fermenting food is a common occurrence, and to this condition the terms "hoven," or "blown," are applied. The causes of the disorder are to be found in the quantity or quality of the food. Sudden change of diet from dry to succulent food tempts animals to indulge to excess, and as the result of the filling of the rumen with half-masticated food, digestion is interrupted and fermentation occurs, the stomach becomes rapidly filled with the gases which are given off, and pressure on the diaphragm is the consequence; and sometimes, before any effectual help can be rendered, the animal dies from suffocation.

Promptness of action is essential in dealing with "hoven," and especially when it occurs in a flock of sheep which have just been turned on to a luxuriant field of clover; in such circumstances the extreme measure of plunging a knife into the swollen stomach, and allowing the gas to escape, has been justified by the successful result, and when an animal is on the verge of suffocation, no hesitation can be permitted. The less urgent cases will be amenable to treatment of a milder kind.

Of the numerous medicines which are in favour with stock-owners as remedies for hoven, none is more effective or safe

than the hyposulphite of soda, which, owing to its use in photography, may be obtained at all times and in all places. The dose for cattle is four ounces in a pint of water, and for sheep a fourth of that quantity. Accuracy in apportioning the dose is not of much moment. The chief consideration is that enough shall be given to arrest the process of fermentation without delay.

After an attack of hoven, abstinence from all food for some hours should be enjoined, and then only easily digested aliment should be allowed, and even this should be restricted as to quantity, until the distended sac has recovered its tone.

Diarrhœa (*scouring*), especially among calves and lambs, is an annoying disorder, which in many cases leads to serious loss.

While the disease is confined to a few animals it will excite but little attention ; but its general existence in a flock of lambs or among a number of calves is an indication that there is some radical error in dietetics, which must be corrected, or some adverse climatic influences, from which the animals must be protected before any attempt is made to cure by the aid of medicines.

The farmer is especially cautioned against the use of advertised specifics for this complaint. No medicines are of any real use until the causes of the disorders have been detected and removed, and the aid of an expert can hardly be dispensed with in this inquiry.

As a guiding principle it may safely be assumed that scouring is due to something in the food, viz., either in the milk of the mother, when sucking animals are attacked, or in the herbage or other food which is supplied to older animals. When the milk is in fault, its pernicious qualities must be referred, as a rule, to the food which the cow or ewe receives. In fact the question will resolve itself in most cases into that of the quality of the food or water with which the young animal or the mother is supplied.

Exposure to wet and cold will add materially to the adverse influences which have been referred to, and may in themselves act as exciting causes of the disease.

Presuming that the causes of the derangement have been detected, and as far as possible got rid of by changing the position of the animals and correcting all discovered errors in diet, there will not remain much need for the aid of medicines.

An old-fashioned mixture, which represents the chalk mixture of human medicine, may be kept at hand, and administered as required in cases which do not improve with the change of conditions in regard to food and locality. The mixture is termed in Morton's 'Pharmacy' "sheep and calves' cordial," and

the preparation will be found in the list of necessary medicines at the end of this essay.

Parasites.—Worms of various sorts inhabit the intestinal canal and other organs of digestion, and induce irritation, which is often associated with diarrhœa and general unthriftiness. Horses, cattle, and sheep, are victims in different degrees to the ravages of parasites. It is only necessary to allude to tape-worms in lambs, and the destructive fluke-disease, to show that internal worms have much to answer for in the matter of disorders of the digestive system; but the subject of parasitic diseases is far too extensive to be dealt with in a mere sketch of the common diseases of farm stock to which common domestic remedies are applicable. It may, however, be remarked that for horses a general and effective worm-killer is to be found in the agent santonine, which may be given in doses of 15 grains in a ball with 3 drachms of aloes, and repeated in a few days if necessary; while for worms in the digestive organs of sheep no remedy has yet been found which equals in efficacy common salt. Powdered charcoal has recently been advocated, and, being a harmless agent, is worthy of fair trial.

Diseases of the Breathing Organs.—Atmospheric changes naturally exercise great influence on the breathing organs, and in a variable climate derangement of those organs is of constant occurrence. The ordinary term "cold," is used to express different forms of respiratory disorder with which actual cold has often little or nothing to do. Warm, moist weather is more fruitful in cases of common cold than really cold seasons are, and it has been remarked that the words catching a heat would be more accurate than the usual form "catching a cold."

The ordinary symptoms of a cold are—dullness, loss of appetite, redness of the mucous membranes, of the eyes, nostrils, and mouth, with irritability of the air-passages, as evidenced by the occurrence of cough when cold air is drawn into the windpipe. Discharge from the nose and eyes appears as the disease advances, and in severe cases the extension of the irritation to the bronchial tubes leads to difficulty in the breathing. Cattle cough or "hoose" frequently when in health, and so do sheep; but there is a difference which the practical observer can appreciate between the habitual "hoose," and the cough which is due to irritation of the mucous membrane lining the air-tubes. Treatment of a common cold is always carried out on a routine system by the aid of certain drugs, which are presumed to have a specific effect; but it may be questioned whether either man or the lower animals can be cured of a cold by the agency of medicines.

Good nursing is undoubtedly beneficial in common colds, and

if the patient is kept from exposure to cold or wet, properly housed and clothed, and fed on soft non-exciting food, to which, or to the drinking-water, a little nitre is added, and has a dose of an electuary (see end of this paper) from time to time, very little more can be done.

Stimulating liniment may be rubbed into the skin of the throat and front of the chest when the cough is troublesome; but blisters and setons should never be used without the advice of a veterinary surgeon, and under no circumstance should the farmer be tempted to give any of the advertised cough-balls, or other specifics. If the cold resists the simple measures which have been advised, it is a sign that something more than appears to the inexperienced eye is wrong, and further advice should be sought.

Influenza is a peculiar form of catarrhal disease which occurs periodically among horses, generally in the summer and autumn, and, under certain unfavourable conditions, results in serious loss. Under the names of "Horse Distemper" and "Pink Eye," the affection has of late years excited special attention in this country, chiefly on account of the presumption that it was imported from America. There is nothing, however, in any phase of the influenza of recent date which distinguishes it from the affection of a quarter of a century ago.

One special feature of influenza, as compared with ordinary cold, is the remarkable prostration which occurs early in the course of the disease. Complications also occur during the progress of the affection, and from the simple catarrhal form it may pass to the organs of the chest (thoracic form), or to the intestines, inducing enteritis: or it may become associated with disturbance of the brain and spinal cord, and present the characters of the very fatal disorder which is known by the pretentious title of "*cerebro-spinal meningitis;*" and finally, it may be combined with acute rheumatism.

Treatment of influenza will necessarily be regulated by the nature of the attack, and, in regard to the domestic veterinary treatment of the disease, it may be remarked that the simple remedies which are at the disposal of the farmer will, if promptly and judiciously applied, materially modify the severity of the affection, and especially at its commencement. As soon as signs of influenza are evident in the animal's drooping gait, watery and perhaps swollen eyelids, work should be stopped. The neglect of this essential precaution led to the loss of a vast number of horses of the Tramway Companies in America a few years ago.

Good nursing is all-important in influenza as in all forms of catarrhal affections. A sick horse should be placed, if possible,

in a well-ventilated box, and be tempted with any kind of food which may stimulate the failing appetite; water should be placed within reach, and a little nitre, half an ounce to the bucketful of water, may be dissolved in it daily, but the fluid should on no account be made lukewarm, as nothing is more distasteful to most horses. Sponging the nostrils occasionally with vinegar and water refreshes a sick animal much, and the creature's comfort will be further promoted by attention to the temperature of the surface of the body and extremities; bandages to the legs, warm or cool covering to the body, according to the season, and friction to the skin, are all valuable curative measures which are within the scope of domestic treatment of disease.

Beyond the provision of nitrated water for the sick horse to drink, the farmer cannot safely do much in medical treatment; but if sore throat and cough are present, the electuary, the composition of which is given in the list of necessary medicines at the end of this essay, may be employed with advantage. A small portion of the compound should be introduced into the mouth by means of a flat piece of wood, or it may be smeared on the tongue with the hand.

Influenza in its common catarrhal form may be successfully treated in the manner above described, but it must not be forgotten that the development of fresh symptoms indicative of complications, should be the signal for calling in veterinary aid.

Inflammation of the Lungs, Bronchitis, or Pleurisy, are serious diseases of the breathing-organs arising out of, or at any rate following closely on, a common cold in many cases. It is worse than useless to attempt the cure of these maladies by the use of domestic medicines. The old methods of bleeding, blistering, and rowelling, are now deservedly exploded, and milder remedies have taken their place; but the effective use of these remedies demands the skill of the experienced practitioner.

In general terms it may be said that so long as the disorder of the breathing-organs is confined to the upper part of the air-passages, and the animal can cough out well and strongly, lies down as usual, and does not refuse food and water, the farmer may be content to continue the system of nursing, and by way of medical treatment he may give half an ounce of nitre per day in the food or water; but domestic veterinary treatment should not be carried on when the animal's breathing becomes rapid or oppressed, the cough soft and painful, and the animal refuses to lie down, or to take food or water. Under these circumstances the farmer may be sure that he has more than a common cold to deal with; and if he values the animal, he will get the best assistance without a moment's delay.

Parasites in the air-passage are responsible for considerably more damage than those which inhabit the digestive canal. The threadworms which infest the bronchial tubes of calves and lambs, and cause constant irritation and incessant cough or husk, have long been known to farmers, and dreaded the more as every year shows the futility of preventive measures from which much good was expected. Unfortunately, lands which become infested with the germs of the threadworms cannot be freed from the pest except under the influence of long frosts or continued hot dry weather, conditions which have been conspicuous by their absence for many years past, certainly the most essential one—dry weather—has.

Treatment, to be successful in the cure of lung disease from the presence of threadworms in the bronchial tubes, involves two essentials: first, the destruction of the parasites; and secondly, what is often the most difficult, the removal of the diseased animals to a position in which they will escape the risk of reinfection. Turpentine is a favourite remedy, but it must be given with care. The best plan is to apportion the dose—a tablespoonful for a calf, and a teaspoonful for a lamb, and then mix the quantity with four times the amount of milk and eggs beaten together.

A more direct plan of bringing remedies in contact with the worm is to inject them directly into the windpipe with a syringe, as advocated by Dr. Levi of Pisa. This plan of administering medicines has lately been tried with great success in France in treating worms in the lungs, and it is time that English veterinarians took up the practice which promises such good results.

Under any system of treatment of the disease it is very essential to support the animals by means of good food.

Accidents and Diseases associated with Calving and Lambing.—In these days of high breeding in all classes of farm animals, the time of parturition, and especially the season of lambing, is one of considerable anxiety to the owner of valuable stock. Abortion, or the expulsion of the fœtus at any time before it is sufficiently developed to live,—and premature birth, or the expulsion of the fœtus prior to the natural time, but in a state of development which permits it to maintain an existence when separated from the mother,—are two accidents which are so necessarily associated with breeding that they cannot be certainly prevented. Careful management, including a supply of good food, avoidance of exposure to inclement weather, and the removal of all causes of excitement, will effect much in the way of prevention; but the flock-master must not expect perfect

immunity from the misfortunes which are incidental to the system of breeding.

It has been suggested that one important measure of prevention is the immediate rejection, for breeding purposes, of all animals which have once suffered from abortion. It is perfectly well-known that the occurrence of the event in a herd of in-calf cows causes extraordinary excitement; and it is rare, indeed, for the mischief to cease with a single case. As soon as any signs of derangement are seen in one or more of the pregnant animals, it is necessary to remove them from the vicinity of the rest, and keep them in a place where perfect quiet can be secured. The diet in such circumstances should be rather low, and a mild laxative, 12 oz. of Epsom salts in a pint of water, with 10 drops of tincture of aconite, may be given; and if the animals continue to show signs of restlessness, the dose of aconite may be repeated in half a pint of water three times during the day.

Should abortion occur in a herd suddenly, the cow which has suffered should be removed at once, and all traces of the occurrence be got rid of as quickly as possible, and those parts of the pasture which have been contaminated with the discharged fluids, or by contact with the expelled fœtus, should be covered with quicklime and, if possible, be hurdled off. It is hardly necessary to remark that the movement of all the herd to another pasture is highly desirable.

Practical men have long sought for the causes of abortion, but hitherto nothing has been discovered which can be referred to as the special influences by which the derangement is produced. Very often at the time of the occurrence all the surrounding circumstances are of the most favourable kind; but abortion, and other disasters which may happen at the time of parturition, are not necessarily due to causes which are existing at the time. On the contrary, the mischief might be traced back to an early period in gestation, and it cannot be too strongly urged that bad management, poor food, and exposure to inclement weather at any time during the progress of fœtal growth will infallibly tell at the last. It cannot, however, be questioned that abortion may occur year after year in herds which are so well managed that the most critical inquirer cannot discover any error to be remedied. In such a case the only thing which can be suggested is the radical measure of changing the herd entirely, a step which the owner of a favourite breed will not generally be disposed to take.

Difficult Delivery.—The act of parturition is rendered difficult in certain cases from malformation in the mother, or some

alteration in the position of the fœtus. In either instance experience and manual skill are necessary to deal with the difficulty; but it too often happens that brute force is used instead—literally brute force in some cases, as it has more than once occurred that a horse has been attached by means of a rope to the fœtus, which has thus been dragged from its position.

It would be useless to attempt, in the course of a short essay dealing with the common diseases and accidents which befal the animals of the farm, to give a description of the numerous malpositions which the fœtus assumes, or the means of rectifying them; nor is it necessary that the attempt should be made, as the lecture on the subject delivered many years ago by Professor Simonds, and published in the Society's 'Journal,' is within the reach of all the members; and it is not too much to say that the surgery of parturition as therein described has not been superseded by any improved methods.

After the act of calving has been completed without accident, there remains in the mind of the stock-owner a certain amount of apprehension, from which he cannot escape for some days; and the more valuable the stock, the greater the anxiety.

"*Dropping* after calving" is a disease of which most breeders know the serious nature. No affection is more fatal among breeding herds; and in certain breeds, and notably among the choicest of the Channel Island races, the liability to the disorder seems to be most marked, and especially after the third and succeeding periods of calving.

Nothing is known as to the actual causes of "dropping," and all that has been said about the throwing back of a large quantity of blood upon the system of the cow as soon as the calf is born may be rejected as having no meaning. The act of delivery is certainly of the nature of a crisis, and if "dropping" were usually the result of a first calving, which is the most critical time in an animal's life, the common explanation might be accepted; but the fact is that the cow is fairly safe at the first and second calving, and even at the third the risk is not great; but the real danger appears after the system may be supposed to have become accustomed to the excitement which is associated with the parturient period. Prevention of "dropping after calving" is a subject which has exercised the minds of practical and scientific men from time immemorial, and certain precautions are suggested with confidence by those who have found them effective, a confidence which is not always justified by the experience of others.

Some breeders assert that the practice of continuing to milk in-calf cows quite up to the time of calving is a successful prevention of "dropping." The more obvious plan of ceasing

to breed from animals after the third calf will not commend itself to owners of pedigree stock; and generally the preventive measures resolve themselves into those sanitary regulations which every considerate breeder naturally adopts—such as attention to the general health, regulation of the supply of food to the amount of exercise, so as to avoid plethora on the one hand, and poverty on the other; and the occasional administration of a moderate dose of laxative medicine. Treatment of "dropping after calving" is not in most cases successful, and considering that experienced veterinarians commonly fail to effect a cure, the farmer will hardly expect to cope with the disease by the aid of domestic remedies.

The "lambing time" is not less important to the flock-master than the period of calving is to the owner of a valuable herd, and perhaps the misfortunes which are common to the first-named are more certain, as they are numerically higher than those which are incidental to the second. The fact is not remarkable, considering how little attention is often paid to the comfort of the breeding ewes at the time. Very frequently the animals are only partially sheltered, folded on damp ground, and kept almost exclusively on watery food; under such unfavourable conditions losses both of ewes and lambs happen almost as a matter of necessity.

A further cause of mischief is to be found in the well-intended efforts of the shepherd to assist delivery when no assistance is required; application of force in the removal of the fœtus is, however, very objectionable; but in addition to the risk of injury which is incurred, there is the even more serious danger of septic infection, as it is called, from the dirty condition of the hands of the attendants, which are often covered with blood in a state of decomposition, and with other septic matters, no respect being paid to the well-known fact that the mucous membrane of the uterine passage is in an excited condition at this time, and prone to suffer from contact with infective matter of any kind. Absorption of septic germs takes place very rapidly, and blood-poisoning is the natural consequence.

Inflammation of the Womb, or Parturient Fever, is a fatal disease to which ewes are liable, and it is quite certain that it may be extensively communicated, and is not unlikely to be originated by the agency of the shepherd's hands being charged with septic material.

The term "straining" is used to indicate these affections, and it is sufficiently expressive; the symptom in itself is easily recognized by the shepherd who, knowing the fatality which attends the malady, is always on the look-out for the first sign of its appearance.

Treatment of *straining after lambing* must be promptly applied, and fortunately there is a remedy which is at once effective. Some time ago Mr. Henry Woods called the attention of flock-masters to the frequent occurrence of straining after lambing, and advocated the use of carbolic acid with 8 parts of Gallipoli oil, for the purpose of smearing the passage after delivery, in all cases in which any signs of inflammation of the womb were apparent. The remedy has been used with remarkable benefit. Dr. Fleming, President of the Royal College of Veterinary Surgeons, pointed out about the same time that the remedy was referred to in his work on 'Veterinary Obstetrics' as being in use on the Continent; but Mr. Woods was the first to introduce the agent to the special notice of the stock-owners in this country.

During the whole time of lambing absolute cleanliness should be insisted on in regard to all the appliances in the lambing-pens. The shepherd should frequently wash his hands in a weak solution of carbolic acid, 1 part of the agent added to 100 parts of soap and water will suffice for this purpose; and when it is necessary to afford manual assistance in the act of delivery, he should smear his *clean* hands and arms with the mixture of carbolic acid and oil.

In the course of this short essay on a very wide subject, the object has been to bring clearly before the stock-owner a few facts which, although beyond dispute, are commonly ignored. First, the importance of strict attention to sanitary laws has been urged, and next, the impolicy of unnecessary interference with the natural resources of the animal organism. Health depends on original freedom from disease, the outcome of a healthy parentage; its continuance may be to a great extent insured by attention to the ordinary conditions of existence. Pure air, and enough of it, good food and water, each in its proper place and quantity, with exercise regulated by the physical powers of the animal, are the essential conditions of normal life. Domestication disturbs these conditions, and art interposes the aid of medicine in the hope of rectifying the errors of an artificial system, not always with success. Nevertheless, in obedience to the teachings of experience, we may treat the medical art with respect without losing our reverence for the *vis medicatrix naturæ.*

THE MEDICINE CHEST FOR THE FARM.

A list of remedies for the Domestic Veterinary Treatment of farm-stock, arranged in alphabetical order, with the doses for different animals.

Aconite.—Tincture (Fleming's); action sedative; allays fever, and externally relieves irritation. Doses: horse and ox, 10 to 30 drops; sheep, 5 drops; add water in proportion of a tablespoonful to each drop of tincture. For a lotion, use one tablespoonful of the tincture to a pint of water.

Alcohol, in the form of whisky, or brandy, or strong ale, is useful for cases in which the system requires to be temporarily roused from a state of depression. Doses: horse or ox, whisky or brandy, 4 to 8 tablespoonfuls; sheep, 1 to 3 tablespoonfuls. Strong ale, horse and ox, 1 pint; sheep, $\frac{1}{4}$ pint: repeated two or three times a day.

Aloes.—A purgative for horse or ox. The ordinary aloetic mass and the solution should be kept at hand: both preparations must be obtained from a druggist. Doses: horses, 4 to 6 drachms of the aloetic mass as an ordinary purgative. Ox, half a pint of the solution, usually given in combination with linseed-oil, in cases of continued constipation.

Ammonia Liniment.—Made by adding a strong solution of ammonia and oil of turpentine, an eighth part, to soap-liniment. A pint-bottle, carefully stoppered, should be kept at hand. The liniment is useful as an application for sore throat, and for all cases in which an external stimulant is necessary. Must be applied with the hand, and well rubbed into the skin.

Areca Nut.—A useful worm-medicine. The nuts should be kept in a stoppered bottle in a dry place. When required for use, the quantity should be grated by means of a nutmeg-grater. Doses: horse or ox, half an ounce to an ounce of the grated nut, mixed with the food, corn, and bran. Sheep, 2 drachms; dog, half to one drachm.

Calves' Cordial.—A form of chalk-mixture for calves and sheep. To be prepared by a chemist as follows:—prepared chalk, 2 ounces; powdered catechu, 1 ounce; ginger, $\frac{1}{2}$ ounce; opium, 1 drachm; peppermint-water, 1 pint. Dose: calves, 2 to 4 tablespoonfuls; sheep, 1 to 2 tablespoonfuls.

Carbolic Acid.—A powerful caustic and antiseptic, ordinarily used in combination with 50 to 100 parts of water, as an antiseptic lotion to unhealthy wounds, and for disinfection purposes.

Carbolised Cotton and Gauze, to be obtained of the druggist. Valuable antiseptic applications to wounds.

Castor Oil, also *Linseed Oil*—purgatives. Doses: horse or ox, 1 to 2 pints; sheep, 4 tablespoonfuls.

Colic Mixture.—Equal parts of laudanum and sweet spirit of nitre, and an eighth part of chloric ether. A half-pint bottle to be kept at hand. Dose: horse or ox, 2 to 4 tablespoonfuls in three parts of a pint of water.

Electuary.—A soft mass, compounded with honey or treacle: must be prepared by a druggist as follows: camphor, 2 ounces; powdered myrrh, liquorice root, and nitre, of each 8 ounces; extract of belladonna, 2 ounces; treacle, enough to make a soft paste. Dose: horse or ox, a portion of the size of half a walnut to be put at the back of the mouth two or three times a day with a piece of stick. Useful in colds, sore throat, and influenza.

Ginger.—Stimulant: forms an essential part of all cordial powders for exciting appetite; may be given with strong ale in cases of prostration from over-work or disease. Dose: horse or ox, 1 to 2 teaspoonfuls of the powder in a pint of ale; sheep, one-fourth of the quantity.

Mercurial Ointment (blue), to be purchased ready for use, valuable to promote the growth of hair, and in some forms of skin disease; only small quantities may be applied.

Mercurial Ointment (red), binioide of mercury. A good form for blisters in cases of splent or after sprain of tendons.

Nitre (nitrate of potash), diuretic and fever medicine. Dose: horse or ox, 2 tablespoonfuls daily in the drinking-water, or half the quantity in the food. Sheep, 1 teaspoonful in the food.

Salts (Epsom or Glauber), common purgatives for cattle and sheep. Dose: ox, 12 to 16 ounces, dissolved in a wine-bottle of hot water. A tablespoonful of ginger may be added. Sheep, 4 to 6 ounces.

Salicylic Acid.—A valuable antiseptic, effective in the treatment of foot-and-mouth disease. Dose: 4 tablespoonfuls of the acid are to be put in an earthen vessel and dissolved in a quart of boiling-water; hot water is then to be added to make a gallon. This solution is to be used to syringe the feet and lave the mouth and nostrils, and also to wash the udder, and finally to sprinkle over the litter; half a pint of the solution may be added to the gallon of drinking-water every day. The dry acid (powder) may be sprinkled on the feet after they have been syringed with the solution.

Santonine, used to expel worms, one of the most effective agents for this purpose. Dose: horse, 15 grains, with 3 drachms of aloes, to be given in the morning before feeding, and repeated after two days.

Sulphur (Flower of Sulphur), a very valuable alterative. Dose: horse or ox, a tablespoonful, with a teaspoonful of nitre, may be given in the food once a day; sheep, quarter of the quantity. Sulphur mixed with any common oil forms an excellent dressing for mange or surfeit in animals.

Turpentine, Oil of.—Stimulant to the skin. Internally used

to expel worms, useful in "husk in calves." Dose: a tablespoonful daily in half a pint of a mixture of milk and eggs. Lambs, one quarter of the quantity.

Vaseline.—Emollient to the skin, effective in irritation of the surface, chapped heels, mud fever, especially if mixed with an eighth part of trisnitrate of bismuth or carbonate of lead (white lead), or oxide of zinc.

Zinc, Chloride of (Sir William Burnett's Disinfecting Fluid), mixed with fifty to one hundred parts of water, may be used for the purposes for which carbolic acid is employed.

VI.—*On the Cultivated Potato.* By Earl Cathcart.

The cultivated potato and its inherent tendency to degenerate is a subject which in this 'Journal' has never been comprehensively treated, and very profitably it might occupy many carefully studied pages in many volumes. The contents, however, of the current publication had been already arranged, when, with a view to render the approaching season available, it appeared desirable to add a paper, imperfect though it may be, suggestive of seasonable operations and consequently undelayed experiments.

Concerning the importance of the subject of our inquiry—the potato, the bread-root of Great Britain, and the struma which so disastrously affects it—little need be said. In its way the enigma of the nineteenth century, no one kindred topic has probably occasioned the same amount of writing; and the scientific interest is more than equalled by the economic importance of a question so hidden, so difficult, and so apparently insoluble. Plants from the torrid zones rarely become naturalised in England; and there is high authority for stating that the potato has never been naturalised in Europe.* This plant, America's best gift, is of all those cultivated the most liable to be influenced and changed by differences of soil, climate, and treatment. Economically, the productiveness of the potato is unrivalled, yielding per acre, thirty times by weight more than wheat. More than one hundred years have passed and gone since Howard, the philanthropist, characterized the potato as a most valuable part of the sustenance of our fellow-creatures, the labouring poor. We have almost forgotten that some forty years ago, our Government and that of the United States

* 'Ency. Brit.' Current Ed. Art. "Acclimatisation."—Wallace.

obtained between them twenty millions of money for the relief of Irish distress consequent upon the failure of this crop in question, and that sum is inconsiderable as compared with the widespread loss caused by panic, pestilence, and their far reaching consequences. The appearance, in 1845, of an extensive disease in the potato crops in various parts of the United Kingdom, though regarded as a serious calamity to the poorer classes, especially in Ireland, was scarcely deemed a satisfactory solution for the wreck of one of the most powerful Cabinets of modern times. Yet it transpired that it was in this apparently insignificant cause that Sir Robert Peel had found the necessity of his retirement from office. In the face of the alarming prospect presented to his mind by the destruction of a large portion of the staple food of the labouring population, his resolution to maintain the existing Corn Laws gave way, and his secession from power was the consequence.* The American Government has been charged with supineness, it has been told to rise above party to consider mankind. We have an Irish question, and the Irish question is, after all, subordinate to that of the potato and the question of its "constitution!" † Factious cries are usually as impracticable as they are abstract, but such a cry as pacification by means of the potato would have a concrete significance. In the sequel I have a modest suggestion to offer to our Government; meanwhile, I only stay to express a hope that the governments and public scientific bodies, who in the way of preserving the crop in question have done so little in the last hundred years, do not in their secret hearts share Mr. Goldwin Smith's opinion,‡ which, after all, may be that of Dame Nature, namely, that misery and barbarism have multiplied on the British precarious and philoprogenitative potato!

Everything depends on the spirit, the scientific spirit, with which we are imbued on entering upon this inquiry. If, with candour, we ask ourselves what on the subject we really know, echoes from vacant caves in our minds will answer—very, very little. But, says the wisdom of the old common law—the origin of a thing ought to be inquired into. § Again, the law says, inquire into doubtful points, for, by reasoning, we come to the real reason of a thing. Every one, in regard to the present subject, starts afresh to run far on little ground; there

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* "Annual Register," p. 2. 1846.

† In 1881 it was calculated that in Ireland there were six persons for every acre of potatoes, in England fifty persons per acre of that crop. 'Morton's Handbook.'—"Crops."

‡ Goldwin Smith in 'Nineteenth Century,' 16th of June, 1883.

§ Coke upon Lit.

is no confident or due reliance on already ascertained facts, no scientific continuity. We should investigate with a full knowledge of ascertained facts and acknowledged principles, therefore it shall be my endeavour to treat the subject from Sir Walter Raleigh's time to the present, concisely but comprehensively, and with a view to give references to all the authorities bearing on the several branches of the inquiry. There is danger in drawing general inferences from insulated facts—books, and pamphlets, and newspapers alike afford abounding examples of a quack-like tendency towards treating mere symptoms.* It should be our endeavour to promote a legitimate union by bringing about the fruitful connection of facts and laws. We desire the establishment of a true theory that shall account for all the phenomena; we seek a true remedy which must be of general application.† Great progress towards much desired ends will have been attained if without hesitation we can bring ourselves to believe that constantly the spirit of continuity walks abroad with Nature, and that leaps and bounds do not usually accompany her stately march.

The following admirable monograph of De Candolle is the best thing of the kind that has ever been written. After consultation, I decided to give a translation without abbreviation, it having been pertinently observed that the writings of this eminent authority do not usually admit of much condensation.

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* Extracts from Blue-books issued whilst this paper was in the Press:—

Report by Consul Churchill on the Trade and Commerce of Palermo and Sicily for the Years 1881 *and* 1882.

"*Phylloxera.*—This disease of the vines has spread since last year, though not as yet to any alarming extent, being chiefly to be found in the neighbourhood where it was first discovered. The Government still uses bisulphide of carbon, which certainly seems to kill the insect when it reaches it, but unfortunately it also destroys the plant, and by its use many vineyards have been entirely destroyed; the proprietors now complain that the cure is worse than the disease, and maintain that it entirely destroys the vines without preventing the spread of the insect."

Report by Vice-Consul Hayes Sadler on the Trade and Commerce of La Rochelle during the Year 1882.

"There are now, according to the report of the *Phylloxera* Commission, only 71,570 hectares of vines remaining in this Department, and for the most part these are attacked, whereas before the invasion of the *Phylloxera* there were 170,000 hectares.

"The same continued progress of destruction during the year has verified anticipation. Little doubt remains as to the ultimate destruction of nearly all the still existing vines.

"There is no longer any faith here in the power of insecticides to save the great body of the vines, and the present period is one rather of experiment as to the success which will result from plantation of American stocks."

† 'Massachusetts Agr. Report,' 1854. See also Darwin, "Animals and Plants under Domestication," iv., p. 9.

POTATO.*—*Solanum tuberosum*, LINNÆUS.—In 1855 I showed and discussed what was then known about the origin of the potato and its introduction into Europe. I shall now add what has been discovered during the last quarter of a century. It will be seen that the data acquired formerly have become more certain, and that several accessory questions which were rather doubtful have remained such, but with stronger probabilities in favour of what, to me, seemed formerly probable.

It has been proved that at the time of the discovery of America the cultivation of the potato was carried on, with every appearance of an old custom, in the temperate regions extending from Chili to New Granada, at an elevation varying according to the degrees of latitude. This can be gathered from the evidence of all the early travellers, among which I shall mention Acosta, for Peru, and Pierre Cieca, quoted by de l'Ecluse, for Quito.

In the temperate regions of the eastern part of South America, for instance, on the heights of Guiana and Brazil, the potato was not known to the natives, or, if they knew a similar plant, it was the *Solanum Commersonii*, which also has tubercles and is found wild at Montevideo and in the south of Brazil. The real potato is now, indeed, grown in the latter country, but it is so new that it has been called *Batate des Anglais*. According to Humboldt, it was unknown in Mexico, a circumstance which has been confirmed by the silence of subsequent authors, though contradicted to some extent by another historical fact.

They say, indeed, that Walter Raleigh, or rather Thomas Herriott, who accompanied him in several voyages, had brought, in 1585 or 1586, some potato tubercles to Ireland from Virginia. Its name in that country was *Openawk*. From Herriott's description of the plant, quoted by Sir Joseph Banks, there can be no doubt that it was the potato and not the *Batate*,† for which, at that time, it was sometimes taken. Besides, Gerard tells us that he had received from Virginia the potato which he grew in his garden in 1597, and of which he gives a drawing exactly like the *Solanum tuberosum*. He was so proud of it, that in the beginning of his work there is a plate representing him with a flowering branch of this plant in his hand.

How was it that this species was found in Virginia or Carolina at the time of Raleigh, in 1585, whilst the old Mexicans did not know it, and the cultivation of it had not spread among the natives north of Mexico? Dr. Roulin, who has carefully studied the works about North America, assured me once that he had found no trace whatever of the potato in the United States before the arrival of the Europeans. Dr. Asa Gray told me the same thing, adding that Mr. Harris, a man who was very well acquainted with the language and customs of the North-American tribes, was of the same opinion. I have read nothing to the contrary in recent publications; and it must not be forgotten that a plant so easy to cultivate must have spread, even among nomadic tribes, had they possessed it. It seems to me probable that some inhabitants of Virginia—perhaps English colonists—may have received tubers through Spanish or other travellers who were trafficking or seeking adventures during the ninety years which had elapsed since the discovery of America. From the time of the conquest of Peru and Chili in 1535 till 1585, many vessels may have carried potato-tubers as provisions, and Walter Raleigh, who was carrying on a filibustering war with the Spaniards, may have plundered a vessel containing some. This is all the more probable, as the Spaniards had introduced the plant into Europe in 1585.

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* Translation Art. "Pomme de Terre; Origine des Plantes Cultivées." Par Alph. de Candolle. Paris, Baillière et Cie. 1803. 'Bib. Scientifique Internationale,' XLIII.

† Or Sweet potato, *Convolvulus Batatas*.

Sir Joseph Banks and Dunal have been quite right to insist on this fact of first introduction by the Spaniards, as for a long time especial mention was made of Walter Raleigh, who was the second importer, and of other Englishmen who had brought, not the potato, but the *Batate*, which is more or less mixed up with it. And yet the celebrated botanist, De l'Ecluse, had stated the facts with great accuracy. He it was who published the first good description and print of the potato under the significant name of *Papas Peruanorum*. From what he says, three centuries of cultivation have produced little change in the species, for it produced originally as many as fifty tubercles of different sizes, being about two inches long, of an irregular ovoid shape, reddish in colour; they ripened about November [in Vienna]. The flower was more or less pink outside, of a pale pink inside, with five green longitudinal lines; this is often seen nowadays. Numerous varieties have no doubt been obtained, but the original type has not been lost. The only difference between our present plants and the original ones is that De l'Ecluse compares the perfume of the flowers with that of the lime-trees. He sowed some seeds which produced a variety with white flowers, as we see sometimes now.

The plants described by De l'Ecluse had been sent to him in 1588 by Philippe de Sivry, Seigneur of Waldheim, Governor of Mons, who, in his turn, obtained them from some one attached to the Pope's legate in Belgium. De l'Ecluse says that the species had been received into Italy from Spain or America ("certum est vel ex Hispaniis, vel ex America habuisse"), and he is surprised that, having become so common in Italy that it was eaten like turnips and given to the pigs, the *savants* of the University of Padua should have been made aware of it by the tubercles that he sent them from Germany. Targioni could not prove that the potato was as generally cultivated in Italy at the end of the sixteenth century as De l'Ecluse says, but he quotes Father Magazzini, de Valombrosa, whose posthumous work, published in 1623, mentions the species as having been brought previously, without giving any date, from Spain or Portugal by barefoot friars. The cultivation must therefore have spread in Tuscany about the end of the sixteenth or the beginning of the seventeenth century. Independently of what De l'Ecluse and the agriculturist De Valombrosa say about the importation by the Spaniards, it is not at all likely that the Italians should have had any intercourse with Raleigh's companions.

Nobody can doubt that the potato came originally from America, but to tell from what part exactly of that large continent, we must know whether the plant grows there spontaneously, and in which localities.

To answer this question clearly, we must remove two causes of error: firstly, allied species of the genus *Solanum* have been mistaken for the potato; secondly, that travellers may have been mistaken about the characteristics of the spontaneous plant.

The kindred species are the *Solanum Commersonii* of Dunal, mentioned above; the *S. Maglia* of Molina, a species from Chili; the *S. immite* of Dunal, which comes from Peru; and the *S. verrucosum* of Schlechtendal, which grows in Mexico. These four kinds of *Solanum* have smaller tubers than the *S. tuberosum*, and differ also by other characteristics mentioned in works on botany. Theoretically, it may be believed that all these varieties, and others growing in America, come from one original parent stock, but at our geological epoch they offer differences which seem to me to justify their being considered as a distinct species, and no experiments have been made to ascertain whether, by cross-fertilising the wild types, a race might not be obtained which might be perpetuated by seed. We will leave alone these more or less doubtful questions about the species, and try to find out whether the common kind of the *Solanum tuberosum* has been found wild; only let us mark that the abundance of the tuber-producing *Solanum*, growing in the

temperate regions of America, from Chili or Buenos-Ayres to Mexico, confirms the fact of the American origin. Even if we knew nothing more, this would be a strong presumption in favour of America as the native country.

The second cause of error is very clearly explained by the botanist Weddell, who has travelled with so much zeal through Bolivia and the neighbouring countries. "When you think," says he, "that the Indians in the barren Cordilleras often cultivate their plot of ground in places which would seem almost inaccessible to the great majority of our European farmers, you understand that a traveller, coming by chance upon one of those plots, forsaken long ago, and finding there a plant of *Solanum tuberosum* which has been preserved there by accident, should gather it with the idea that it grew there spontaneously; but where is the proof of it?"

Now let us look at the facts. They are numerous as regards the spontaneity in Chili.

In 1822, Alexander Caldcleugh, the English Consul, sent to the Horticultural Society in London some potato tubercles which he had gathered in the ravines around Valparaiso. He says that these tubercles are small,* sometimes red and sometimes yellow, and have rather a bitter taste. "I think," he goes on to say, "that this plant is found to a great extent along the coast, for it exists in the south of Chili, where the natives call it *Maglia*. There must be a confusion here with the *S. Maglia* of the botanists; but the tubercles from Valparaiso, planted in London, have produced the real potato, which is obvious when one sees the coloured plate of Sabine † in the 'Transactions of the Horticultural Society.' For some time this plant was being cultivated, and Lindley testified again, in 1847, to its identity with the common potato.‡ A traveller gave Sir William Hooker the following explanation about the plant from Valparaiso. "I have noticed the potato on the coast as far as fifteen miles north of this town, and also in the south of it, without knowing to what distance. It grows on the cliffs and on the hills near the sea, and I do not remember having seen it more than two or three miles from the coast. Though it is found in mountainous parts, far from cultivated ground, it does not exist in the immediate vicinity of the fields and gardens where it is planted, except when a stream runs through these places and carries the tubercles into the uncultivated spots." The potato described by these two travellers had white blossoms, just like some varieties cultivated in Europe, and like the plant sown long ago by De l'Ecluse. This is probably the primitive colour of the species, or at least one of the most frequent in the spontaneous state.

During his voyage of the 'Beagle,' Darwin § found the potato wild in the Chonos Archipelago in Southern Chili, where it was growing abundantly in the sand on the seashore, and vegetating with a strange vigour, attributable to the damp climate. The largest specimens were four feet high; the tubercles small, though one of them measured two inches across. They were watery and insipid, but had no bad taste after being cooked. "The plant is undoubtedly spontaneous," says the author, and the specific identity has been confirmed, first by Henslow, and then by Sir Joseph Hooker in his 'Flora Antarctica.'

A specimen in our herbarium collected by Claude Gay, and attributed to the *Solanum tuberosum*, bears on the label: "In the heart of the Cordillera of Talcagoué and Cauquenès, in places visited only by botanists and geologists." The same author, Cl. Gay, insists in his 'Flora Chilena' on the frequency of the wild potato in Chili, even among the Araucanians in the

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* Sabine, 'Trans. Hort. Soc.' vol. v. p. 249.

† Sabine's plant represents *S. Maglia*, not *S. tuberosum*. Note by J. G. Baker.

‡ A. Cruckshanks.

§ Darwin's plant was *S. Maglia*, not *S. tuberosum*.—J. G. B.

mountains of Malvarco, where Pincheira's soldiers went to fetch them for food. These evidences sufficiently prove the potato to be indigenous in Chili, without mentioning the less convincing ones of Molina and Meyen, whose specimens from Chili have not been examined.

The climate of the Chilian coast prevails on the heights along the Andes, and in the temperate regions of Peru the cultivation of the potato is very ancient, but the spontaneity of the species is much less palpable than in Chili. Pavon protested he had found it on the coast at Chancay and near Lima. These localities seem very hot for a plant which demands a temperate or rather cold climate. The specimen in Mr. Boissier's herbarium, collected by Pavon, moreover, belongs, according to Dunal, to a different kind, which he calls *Solanum immite.* I have seen the authentic specimen, and have no doubt that it is a species quite distinct from the *S. tuberosum.* Sir W. Hooker mentions a specimen of MacLean, from the hills about Lima, without giving any information as to its spontaneity. The specimens (more or less wild?) which Matthews sent to Sir W. Hooker from Peru, belong, according to Sir Joseph, to some varieties differing a little from the real potato. Mr. Hemsley, who saw them recently in the Herbarium at Kew, thinks "they are distinct forms, yet no more than varieties of the species."

Weddell, whose caution in this matter is well known, thus expresses himself:—"I have never met with the *Solanum tuberosum* in Peru in such circumstances as to leave no doubt about its being indigenous; I even declare that I do not believe in the spontaneity of other specimens found here and there in the Andes beyond Chili, and considered until now as indigenous."

On the other hand, M. Ed. André has collected with great care, in two elevated and wild spots of Columbia, and in another near Lima, on the mountain of the Amancaes, some specimens which he thought he could class with the *S. tuberosum.* M. André has had the kindness to lend me them, and I have compared them attentively with the types of Dunal's specimens in my herbarium, and M. Boissier's. Not one of these *Solanum* belongs, in my opinion, to the *S. tuberosum,* though that from La Union, near the river Cauca, resembles it more than the others, and what is more certain still, not one of them corresponds with Dunal's *S. immite.* They are nearer the *S. Columbianum* than the *tuberosum* or *immite.* The specimen from Mount Quindio presents a very peculiar feature; it has ovoid and pointed berries.

In Mexico it seems that the *tuberous Solanum,* ascribed to the *S. tuberosum,* or, according to Mr. Hemsley, to kindred species, cannot be considered as identical with the kind which is cultivated. They are related to the *S. Fendleri,* which M. Asa Gray considered at first as a true species, and afterwards as a variety of the *S. tuberosum* or of the *S. verrucosum.*

We may draw the following conclusions:—

1. The potato is indigenous in Chili, in a form which is still seen in our cultivated plants.
2. It is very doubtful whether its natural habitat extends as far as Peru and New Granada.
3. The cultivation was spread before the discovery of America from Chili to New Granada.
4. It had been introduced, probably in the second half of the sixteenth century, into that part of the United States which we call Virginia and North Carolina.
5. It was imported into Europe from 1580–1585, first by the Spaniards, then by the English, at the time of Raleigh's voyages to Virginia.

De Candolle having presented to my readers a most instructive view of the general history of the potato, it seems to me that an

historical retrospect from the practical British farmer's standpoint would be a convenient method of logically conveying some useful information and much food for reflection. I do not pretend to be a man of science. I do not dogmatise; I seek only to elicit information, and to bring to bear on the present inquiry a mind, naturally inclined that way and trained from boyhood to practical investigations. When I look over the hedge into the vast domain of science, it is with cap in hand, to beg for information; if need be, for correction. Indeed, that increasing domain in these days must, for profitable cultivation, be parcelled out into many various-sized farms and fields —it is essential, in scientific economy as in political, that there should be organized division of labour.

"I laboured," said that fine old potato-grower, Gerard*—and at the present day what could be better said—"I laboured with the soil to make it fit for the plant, and with the plants to make them delight in the soil in order that they might prosper as in their native country." As in 1597, so in 1884, this is a golden rule of culture. Shakspeare† mentions the potato twice only, and then in reference to their supposed erotic qualities:—"Let the sky rain potatoes. . . . Let there come a tempest of provocation." The great Lord Bacon, for whose comprehensive mind nothing was too great and nothing was insignificant, busied himself scientifically and economically with the then novel potato-plant. A great delicacy in the time of King James the First, potatoes sold for two shillings a pound—two shillings in those days being a considerable sum. Some years later, namely in 1663, Mr. Buckland of Somersetshire called the attention of the Royal Society to the cultivation of the plant as of national importance; his suggestion was cordially adopted by that illustrious body. The importance of the potato as "food for swine, cattle, and poor people," and as a safeguard against famine, having, during thirty subsequent years, been established,‡ Sir Robert Southwell, probably as a consequence, informed the Fellows of the Royal Society that to succour the starving, when the civil wars had devastated the corn-crops, his grandfather first cultivated potatoes in Ireland, and that he had them from Sir Walter Raleigh. Yet the potato had still to struggle for recognition, because a hundred years after their first introduction there is no mention of it in a then standard book, 'The Complete Gardener.'§ However, a favourite old book of mine, 'The Gentleman's Recreations,' 1710, contains the following patronising notice of the new esculent: "it is greatly in

* Gerard, Herball, 1597.
† 'Merry Wives,' act v. sc. 5. Troil. and Cress., act v. sc. 2.
‡ Dec. 13, 1693. § London & Wise, 1719.

request in American plantations, also in Ireland, and will no doubt grow if planted in England; it requires garden-mould." The Duchess of Buccleugh's 'Household Book,' for the year 1701, mentions a peck from Edinburgh, which cost 2*s.* 6*d.*; but this instance was exceptional, because until the latter part of the last century, when famine driven, the cultivation proportionately outstripped that in England, the Scotch were averse to the potato. There is no mention of it in the Bible. To those who know intimately the Scotch domestic history of the period, this fact, in the strong language of those days, was "damnably uncanny:" besides, as we have seen from our Shaksperian reference, the potato had then a bad moral reputation, which must have greatly influenced a community that dealt furiously with irregularities of the affections—for example, one Currie, a tailor, was in 1692 sentenced to death for wedding his first wife's half-brother's daughter.*

Man has been defined as a tool-making-animal. If we sought to raise up a perfect example—and desired to exclaim, "Behold a man!" we doubtless should have recourse more to the oatmeal "girnal" than to the potato pie. It is calculated that 100 parts of good wheat-flour contain as much actual nutriment as 613 parts of potatoes.† Limited cultivation and the lazybed system had to a great extent kept the plant healthy: this natural and necessarily distributed culture was now to be superseded by extensive field-cultivation, whether in hillocks, drills, or on the flat. Field-cultivation, which greatly increased the national wealth, dates from about the year 1728, when, owing to forced cultivation and unnatural propagation, the plant soon developed that tendency to disease which by its ratio of increase became afterwards a puzzle and a terror. Burton ‡ the historian has it that the potato was not introduced into the West Country of Scotland until twelve years later, but there he is probably mistaken, because Lord Cathcart § mentions in his diary, under date Feb. 26, 1728, that at Dalmellington, in Ayrshire, he was busied with the cultivation of potatoes. On Saturday the 13th of July, 1734, he visited Thomas Fordyce of Cranston, near Edinburgh, and went over his farm, to return delighted with *the fifty acres of potatoes*—and not bad for the period; on the Sunday they took a turn round to see the cattle, the sainfoin, and

* Chambers, 'Dom. Annals Scot.,' vol. iii. p. 59.

† The tuber in a fresh state contains about 71–80 per cent. of water; 15–20 per cent. of starch; 3–7 per cent. of fibre; 3–4 per cent. of gum, sugar, &c.; and only 2 per cent. of the albuminoids or flesh-formers. 'Chambers's Encyc.:' Art., Potato.

‡ Hist. Scot., v. ii. p. 397.

§ General Charles, 8th Lord Cathcart, died in command of expedition to Carthagena, 1740.

the lucerne. The Scandinavians were rather behindhand, for the 'Gentleman's Magazine' for 1764 mentions that, though introduced in 1720, the potato was not generally cultivated in Sweden until 1764, notwithstanding the great Linnæus, his learning and industry. That destructive and continuous disease, the Curl, says Mr. Rham, an exact authority, was first noticed in this same year, 1764; during 60 or 70 years it ravaged and devastated acres, fields, and districts. It has been well said the liability of the plant to disease is not the least of its peculiarities; diseases date from cultivation. Partial though the affection, the Curl, may have appeared, it yet broke out in the same form in widely separated countries. Stephens,* the most practical writer I know, characterises the Curl as weakness: the leaves curl and crumple; when virulent, they shrivel; the tubers are small, and rot; the herbaceous stems are puny, and a small insect feeds on the stem; some call this the cause! A few plants curl one year, planted the next, half the crop will prove diseased: the disease is hereditary. Degeneracy is not only a disease, but the predisposer to acute disease, the struma of the potato; Dr. Playfair says it is consumption as in overgrown youth—the liability to disease is as old as the potato. With decay, mould or fungus there must have prevailed, indeed there is evidence to that effect. Microscopic manipulation, in its modern application, was, it must be remembered, almost unknown, and consequently the special character of a special fungus was not recognised; but that fact has little signification to those who know that throughout nature there are infinite varieties of the same parasites; for example, cat-fleas, dog-fleas, monkey fleas, human fleas, and others, all under the microscope different, and well known. In the 'Gentleman's Magazine' for this year, 1764, there is at page 333 an interesting paper, "Mould your potatoes up monthly," says the writer, "continue moulding up." In the same publication for 1771,† there is addressed to the Society of Arts, in London, a most valuable memoir on a new potato, by John Howard, Esq., of Cardington, in Bedfordshire: this was the famous prison philanthropist, High Sheriff two years afterwards, and by taste nearly a vegetarian. A traveller, a scientific observer,

* 'Book of the Farm.'

† Philip Miller, in his 'Gardeners' Dictionary,' Edit. 6, 1771. "This plant has been much propagated in England within thirty or forty years past; for although it was introduced from America about the year 1623, yet it was but little cultivated in England till of late, the roots being despised by the rich, and deemed only proper food for the meaner sort of persons. However they are now esteemed by most people, and the quantity of them which are cultivated near London, I believe, exceeds that of any other part of Europe." He gives detailed cultural directions, and makes no mention of any disease.—J. G. B.

a Fellow of the Royal Society, a man of determined accuracy, six years previously he had planted in hillocks, 6 feet asunder, a new potato fresh from America; each set produced from 26 lbs. to 27½ lbs. Single potatoes became so large, he was obliged to plant in 3 feet drills to reduce the size. When I stript a stem I found, he said, the tuber died; in outside rows and hillocks the plants do best, there is more sun and air; wet summers, he says, benefit the potato, but then it must be remembered there was plenty of space. Mr. Howard's drills were 3 feet distant and cuttings 3 feet asunder: these distances I have in my own experience found advantageous.

In France potato cultivation was originally very unpopular; Louis XVI., in 1785, had great difficulty in establishing it as a guarantee against famine. A close observer, Parmentier,* who introduced the potato into France, accurately described the potato disease now known as the disease of 1845; but until the great outbreak, 1845, '46, the atmospheric conditions had been more local than general. The next year, [1786], a correspondent under the initials J. H. wrote to the 'Gentleman's Magazine' asking for the natural history of the potato—"Can't find any satisfaction in any book: Whence? When? What? We know nothing of the causes that improve, nothing of those which degenerate?" Under every combination of all the letters of the alphabet the same query in our day might well be propounded. In the 'Hortus Americanus,' † by Dr. Henry Barham, an author of whom Sir Hans Sloane spoke highly, it is said that potatoes grow in America in most parts in great plenty, but as they put nothing for them to run on, they creep and spread on the ground, destroying the grass: the potato is a cheap bread-stuff food for both white and black. We have now reached the commencement of the era of really greedy cultivation; the Parliamentary Board of Agriculture, in the alarming crisis of 1795, offer a premium of 1000*l.* for the largest breadth of potatoes grown on land never before so applied. Then there is much about varieties, some say the kidney is liable to curl; the Surinam, it was asserted, never curls. Dibbling on grass mentioned; there are directions for the application of 20 tons of manure per acre; the sets to be dropped

* Parmentier, "Traité sur la culture, &c., des pommes de terre, Paris, 1789." Brit. Museum [Sir Joseph Banks's Copy] 452, e. 30. "Dès que les pluies sont abondantes à l'époque de la plantation ou de la récolte, les pommes de terre noyées d'eau pourrissent bientôt, si les terrains auxquels on les confie sont de la nature glaiseuse, propre à retenir l'humidité, et à la rassembler en masse; alors les tubercules parsemés de points blancs et brillants, acquièrent la consistance d'une pâte liquide semblable à de la bouillie, et ils exhalent une odeur infecte," p. 59.

† 'Gentleman's Magazine,' 1795, p. 844.

on it at 9 inches apart; aim at 200 or 300 bushels an acre. In Scotland, Cornwall, Cheshire, Lancashire, and near London two crops have been taken; very early crops having been obtained by the careful manipulation of sprouted sets. The President of the Board, Sir John Sinclair, the originator of the unrivalled statistical account of Scotland, a voluminous writer, and truly a public soul, was busily engaged, both pen and voice, during the potato failure of this disastrous year of 1795. The failure of the crop was disastrous.* Peaty-stuff is mentioned as useful in keeping dry land damp and strong land open; straw also as useful in keeping strong land open: I myself had some evidence as to a fine crop grown in what was thought hopeless, brick-like clods. Lime was supposed to induce curl and canker. The Rev. Mr. Campbell instituted in 1790 some suggestive experiments in Argyleshire, the results were these—productiveness is not dependent on the size of the sets, but on their having that perfect number of stem-growths which the soil they feed on can furnish: the roots from plants at 12 inches are much larger than those at 6 inches apart. The importance of the leaf-haulm is not duly considered. Now to me the following observation appears highly important; the roots of the plant should occupy the ground as completely as possible, so long as they do not interfere or injure one another. The struggle for life, it has been observed by recent authorities, is usually most severe between individuals of the same species. I find in Rees that there is a reference to the "mould," or fungus, as associated with curl, and this if not earlier is certainly as early as the birth of the present century. Arthur Young's exhaustive annals merit careful study. Wilson, a practical writer, in his 'Agriculture of Renfrewshire,' mentions and approves the system largely adopted in the last century of pulling off the blossoms to hasten the ripening of the tubers. Robert Brown, farmer of Markle, in the county of Haddington, a very practical writer on rural affairs,† says, sets should be rather large than small, the stem depends on the set: and throughout, though there has been much controversy, whole sets appear to be preferred—cutting the set causing weakness. As modern authorities have observed, the tuber contains a store of food put there by Nature to help the plant, the stem, in the struggle for life. The history of the potato from this period down to the formation of the Royal Agricultural Society is a history of frequent and varied disease, and constant degeneration certainly running in the direction of extinction. It was observed by

* Rees 'Cyclopædia,' art. "Potato."

† Edin., 1811, vol. ii. p. 78.

M. Shirreff * that not a single healthy plant of any sort of potato that yields berries, and which was in culture twenty years ago, that is before 1849, can now be produced. Varieties show failure in the ratio of their remoteness from the parent stock ; root propagation of varieties causing degeneration. Lawson, according to Darwin,† gives for the year 1851 a list of 175 varieties then grown in Britain ; he observes, the valuable and selected parts of all cultivated productions present the greatest amount of modification, the tubers especially are wonderfully diverse ; this great authority holds that disease in plants is hereditary. Curl, dry and wet rot, Sir Harry Thompson says, are the same disease ; the taint is a virulent form of dry rot ; a severe type of curl prevailed from 1831 to 1837, it disappeared in that year, but appeared again in 1838 and was the immediate forerunner of the potato disease of 1845. The taint kills the sets ; they decay, there is a wet, black, soapy putrescence—or there is a dry white mouldy decay, or it may be a mixture of rot, wet and dry. The fourth volume of this 'Journal,' 1844, contains a melancholy account of the Bobbin-joan ; ‡ the germs abort, and become little buttons, not leaves, a disease of thirty years' standing, wholesale abortions, it is said, from exhausted vitality. The 'Journal' contains further an exhaustive illustrative catalogue of the insects which affect the potato-crops §—plant-lice, plant-bugs, frog-flies, caterpillars, crane-flies, wire-worms, millepedes, mites, beetles, flies, and others ; some prey on the leaves, some on the tuber. Insects during one hundred years have been constantly charged in all visitations as the destructive agents. This theory, as might be expected, the learned author of the paper, in common with experts at home and abroad, absolutely repudiates ; these entomological visitations he treats as effects due to atmospheric and other remote causes. Happily the all-devouring Colorado beetle ‖ is as yet a stranger. Historically we have them continuously forced upon our attention :—curl, taint, scab, Bobbin-joan, dry rot, wet rot, lice, bugs, flies, caterpillars, worms, mites, beetles, fungi, and other innumerable pests. When nature, Pandora-like, stands with open box from which, without leaving a visible hope at the bottom, all these evils and distempers disperse themselves over the world ; well may the practical man exclaim " goodness gracious ! is the healthy and duly cultivated

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* 'Rural Cyclopedia :' John N. Wilson, 1849, Art. "Potato," to the date a comprehensive and careful monograph, corresponds with and confirms my own reading : I saw it for the first time last summer, Lib. R. A. S. E.

† Darwin, 'Animals and Plants under Domestication,' vol. ii. p. 330, which see.

‡ 'Journal,' R. A. S. E., 1844, p. 14.

§ 'Journal,' R. A. S. E., vol. x. p. 70. John Curtis, F.L.S., &c.

‖ 'Colorado Beetle, Life History.' See 'Journal,' Second Series, vol. xi.

potato-plant designed as a suitable and natural matrix for all these plagues?"

Scab is a disease of the tuber, a fungus, *Tubercinia scabies;** dry rot is also a fungus of the same order, *Fusisporium solani.* This last was first observed in Germany in 1830, where through many years it is supposed to have caused great loss. Wet rot is also fungoid, said to be a fungus of the same type as the dry rot. And this *Fusiporium* † is a little friend and constant companion of the fungus, inseparably associated with the disease of 1845, namely, the *Peronospora infestans.*

We are now brought to the disastrous year of 1845, the year of the great outbreak of potato-disease, a new form of an old disease,‡ which inaccurately has been called by many confusing names, as plague, and murrain. This disease is specially characterized by the full recognition of its fungoid attendant, *Peronospora infestans*, the disease shall in future be simply designated by me as the potato disease of 1845. It appeared in St. Helena in 1840; detected in England here and there the following year; it appeared at various periods about this time in North America; both continents were affected. The disease burst out generally in 1845, and swept whole districts throughout Europe, leaving in its track of devastation famine and suffering and human misery.

From this general historical retrospect we now turn to glance at the particular history of several branches of the inquiry. The sum of all history goes, in my opinion, to show that the cultivated potato-plant has an inherent tendency to degenerate—a factor which consequently must always enter into the problem of the causes of special manifestations of disease; and history further tells us that throughout there has been almost a universal clamour for new varieties.§

The physiology of the potato has yet to be written; ‖ that is

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* Dr. Cooke, of Kew, author of the 'Handbook of British Fungi,' has favoured me with the following note:—Now called *Sorosporium scabies*, and classed with the *Ustilagines*, or "Smut" and "Bunt" of corn. See Fischer de Waldheim, 'Annales des Sciences Naturelles (Botanique),' ser. 6, vol. iv. (1876), p. 229.

† Report, House of Commons Committee, 1880.

‡ Report, Scotch Committee of Scientific Men. The Groningen Commission said the disease had been long known.

§ See, in regard to the time present, an excellent letter from a practical cultivator and hybridiser, Mr. Robert Fenn; he hails with great satisfaction the idea of the *S. Maglia* having, as regards varieties, come to the end of his tether. Mr. Fenn happily describes the potato as the "Cinderella of Nature."—'Journal of Horticulture,' Feb. 7, 1884.

‖ "The physiology of the potato has yet to be written." I should demur to expressing it in this form, because there is no ground for supposing that the potato furnishes any exception to the general laws that regulate the life of all plants. The roots and leaves between them absorb the food, and it is cooked up in the leaves, and they furnish the nourishment needed to build up the flowers and

to say, there is nothing of the kind that I know of in a clear, comprehensive and popular form and to practical men it is a mystery: there is a manifest want in this direction.* Physiology, I need not explain, is that department of natural science which treats of the organs of animals and plants. The plant is constituted in three parts; radical fibres or roots proper, stolons stems, or haulms, as we call them, and the tuber. The radical fibres are the only true roots, and to seek for nourishment for the plant they traverse the soil far and near. A potato tuber is in fact an underground branch, the eyes of the potato are really buds; a tuber, then, is a portion of the stem of the plant in which the tissues become thickened and filled with nutritive matter. Propagation by tubers is not properly reproduction, but plant division, and sooner or later existence in this way must end. A healthy plant is said to have at least ten sets of main roots, four to a set, nearly, if extended end to end, one-third of a mile long, with innumerable mouths or absorbents, say, 25,000, all seeking inorganic matter and water. The practical conclusion from this is that the common potato (*S. tuberosum*) is designed for a dry, very dry, soil and climate. The tuber, so far as Nature is concerned, is constructed only or chiefly for the purpose of propagation: all the plant resides there in embryo, together with a store of suitable food, and the tuber is perfect when no larger than a pea. The roots supply water and earthy salts, to enable the leaves to decompose the carbonic acid absorbed by them from the air. Suppose they absorb more than the leaves can exhale, then the plant is weakened and water-logged. Liebig † says the motion of the sap is caused by atmospheric pressure and transpiration from the leaves; a loaded atmosphere suppresses transpiration, stagnates the sap, and so induces the putrefaction which delights the hovering clouds of fungi-spores or seeds. The potato and the hop, according to Liebig, are especially liable to suffer from impeded transpiration. The same atmospheric influences cause influenza in the human subject, by checking the action of the skin; and curiously enough it is commonly observed in Yorkshire that potato-disease and influenza in horses came the

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fruit. Tubers are a reserve store of nutriment for a plant to draw upon when it cannot get food from other sources, as a tradesman draws upon his investments if he wants to extend his business. If the potato cannot get its food, or cannot digest it like any other organized being, it will fall ill. If the leaves are killed by frost, for instance, it will be unable to digest its food; and if they are attacked and disorganised by fungi, the result will be the same.—J. G. B.

* Mr. Chalmers Morton, to whom we are indebted for many things, has given us in his 'Handbook of the Farm Series,' a useful little work, 'Plant Life,' by Maxwell T. Masters, F.R.S., in which there are six references to the potato.

† 'Motions of Fluids in Animal Body.'

same year.* It is not profitable here to do more than just to touch on that which is the highest possible problem—the essence or origin of life! † Beale says the green chlorophyll ‡ masses are urged on by the actively moving particles of bioplasm: he has most interesting drawings showing the potato cells and the process of the deposition of starch cells. An interesting study of the survival of the fittest was made by Mr. Baker § at Kew, when the power of survival of certain herbaceous plants was thus classified: (1.) Tendency to spread spontaneously, and encroach on neighbours. (2.) Fill-up, but do not spread. (3.) Those that die out and disappear.

Mr. Baker, at my request, kindly made for me the following extract from the 'Philosophical Transactions of 1806,' in regard to which he observes—this experiment is of the essence of the inquiry, and cultivators should bear it constantly in mind:—

"Every gardener knows that early varieties of the potato never afford either blossoms or seeds; and I attributed this peculiarity to privation of nutriment, owing to the tubers being formed preternaturally early, and thence drawing off that portion of the true sap which in the ordinary course of nature is employed in the formation and nutrition of blossoms and seeds.

"I therefore planted in the last spring some cuttings of a very early variety of the potato, which had never been known to blossom, in garden-pots, having heaped the mould as high as I could above the level of the pot, and planted the portion of the root nearly at the top of it. When the plants had grown a few inches high, they were secured to strong sticks which had been fixed erect in the pots for that purpose, and the mould was then washed away from the base of the stems by a strong current of water; each plant was now suspended in air, and had no communication with the soil in the pots except by its fibrous roots; and as these are perfectly distinct organs from the runners which generate and feed the tuberous roots, I could readily prevent the formation of them. Efforts were soon made by every plant to generate runners and tuberous roots, but they were

* 'Journal,' R. A. S. E., vol. xix. p. 10.

† 'Beale on the Microscope.'

‡ Chlorophyll, the green colouring matter of plants, very difficult to get pure, and its chemical composition is not known: obtained by soaking green leaves in alcohol, ether, &c., but it does not dissolve in water; occurs in the so-called "chlorophyll grains," which are merely altered forms of the protoplasm (or living principle) of plants; chlorophyll only becomes green under the presence of light. Bentley's 'Manual of Botany,' 1882. Churchill.

§ J. G. Baker, Esq., F.R.S., Royal Herbarium, Kew, in 'Journal of Botany,' Sept. 1883. The editor observes, in reference to Baker & Newbold's edition of Watson's 'Topographical Botany,' London, Quaritch, 1883: "Mr. Baker, with a critical mind, possesses the faculty of generalisation."

destroyed as soon as they became perceptible. An increased luxuriance now became visible in every plant, numerous blossoms were emitted, and every blossom afforded fruit." *

Atmospheric influences must be touched upon. But I cannot undertake to deal with the gaseous envelope of this whirling world to which, coupled perhaps with electricity, we owe the occurrence of the weather phenomena that undoubtedly affect in high degree the present subject of inquiry. I wish the Meteorological Society could help us. The atmosphere is a spheroidal stratum of uncertain height, 100 to 200 miles, concentric with the earth and pressing heavily on it: a mechanical combination of nitrogen, oxygen, and carbonic acid, in which, like flocks in a sunbeam, animal and vegetable germs, seeds and spores, of disease and putrefaction, hover over all organic life and matter. How far do atmospheric influences stimulate these sometimes latent pests? I cannot answer this important question: but I was much struck at the time, as I am now impressed, by two lectures delivered by Professor Tyndall in January 7, 1876: the first lecture, before the Royal Society, 'On the optical deportment of the atmosphere with reference to the phenomena of putrefaction and infection;' the other, on 'Germs,' was given at the Royal Institution. I heartily wish we could enlist the learned Professor for the National cause in which we are now embarked. Air, he says, isolated and left at rest, is found to deposit its motes and to become pure: in this pure air tempting infusions remained intact, whereas similar infusions exposed in the open air, and owing to germs floating therein, swarmed with bacteria. From another experiment he inferred that germs hover in little clouds and settle at different times. Clouds of disease-germs may explain a puzzle to surgeons: why a wound, going on well for a while, should suddenly and without apparent reason become putrid; it may be that it was dressed just as a germ cloud passed. According to Professor Tyndall, more than by battle, accident, or famine, humanity suffers from disease-germs conveyed in air and water. Green leaves in the sun absorb carbon and leave oxygen, and at night reverse the process. Increase of carbonic acid is dangerous to animals, deficiency injures vegetables. Atmospheric action, similar to that which produces influenza in man, is supposed by Liebig and Klotzsch to be the special cause of the potato-disease of 1845: taken together, epidemic miasmata; the wet summer of 1844; frost, March 1845; the great heat of forepart of that summer. and the uncommon luxuriance of the crop. The Highland Society's 'Transactions' for 1845 mentions disease at end of

* 'On the inverted action of the Alburnous Vessels of Trees,' by T. A. Knight; printed, 'Philosophical Transactions, 1806,' p. 293–304.

August, September, and October: some parts of Scotland in July, in others not until the tubers were stored. In concluding this branch of our subject I mention Mr. Malam's experiment, because it is suggestive; and though I cannot of my own knowledge verify the fact as stated, the experiment may be repeated by any competent scientist. Moreover, the result of the experiment goes to the root of a controversy before the Potato Committee of the Commons as to whether mould-spores rise high in the atmosphere, or whether they fly no higher than a hedge! Mr. Malam * personally told me in 1872, that the Hull Microscopical Society, about the year 1866, witnessed at his house the following experiment. He said: "At 7 A.M. we washed with distilled water a plate of glass 15 inches square, and coated both sides with glycerine, and elevated it in the air about 60 feet; after 6 hours it was taken down and washed on two separate plates with distilled water: on examining under the microscope we discerned spores of fungi; the windward side contained the larger number."

I have instinctively held from the first that there is such a thing as a balance of vegetation, and if so, atmospheric influences must be all-important factors on the maintenance or disturbance of any such balance. As I expressed the idea when I placed my view on record in May 1875, I fancy there is such a thing as a balance of vegetation, that is, a proportion between the several organs of the plant. In warm gloomy weather, when disease is exceptionally rampant, I think the leafy haulm runs away from the rest of the enfeebled plant; in other words, too much sail is carried, and there is a general capsize and consequent wide-spread disaster. The power of the roots is said to be in the ratio of that of the leaves: the roots have great absorbing power, the leaves a low exhaling capacity. The evidence throughout shows that over-luxuriance, from whatever cause, is highly favourable to the disease: in Bengal it is recorded the haulm grew so high, it spent the plant. This balance of vegetation theory, as an essential part of my retrospect, for what it is worth, I simply broach and submit.

Superior vitality, we know, is an attribute for a time at least of certain varieties of the potato that more or less resist disease. Liebig adopts the vital power theory. The Polish letter from the Consul there to Lord Palmerston, and dated October 16, 1846,† is in my view particularly interesting and suggestive; Poland completely escaped the general European destruction. That country, as regards wholesale cultivation and

* The statement was subsequently printed. 'The Potato Disease, Cause and Remedy.' By John Malam, Esq., Scarborough, Theakston, 1873.

† 'Journal,' R. A. S. E., vol. vii. p. 673.

dependency on the happy-go-lucky potato, was a sort of Ireland: the treatment there, I fancy, must have been natural and unforced; any way the important fact remains, the only disease known arose from some kidney sets imported from England. The following remarkable instances of superior vitality came to me from widely separated districts and from persons who could have had no sort of concert; in each of two instances the whole of the crop in a field failed except in places where corn stacks had stood, and there the potatoes grew and prospered; I infer the ground was dry and warm, and hence the superior vitality.

We are now to consider those scavengers of nature, the fungi, a class of cellular plants of which, says Darwin, mushrooms, toadstools, and moulds are familiar examples. These tyrants of the vegetable kingdom seek organic matter in decay as their natural food; their wind-borne spores or seeds hover and pounce like microscopic vultures. The life-history of the fungus or mould, which is inseparably connected as cause or effect with the potato-disease of 1845, has been studied by that eminent scientist, M. de Bary; * the identity of the fungus *Peronospora infestans* and its association with the disease is, without any doubt, ably and clearly manifested, and for this our thanks to that learned gentleman are justly due. But what then? for all practical purposes, and after eight years' of incubation, any discovery in this direction is as barren of tangible fruits as the fig-tree of Scripture. M. De Bary observes—and here I am sure he carries us all with him—"the best place to turn to for further study would be the native land of the potato-plant." † All the *Peronosporæ*, says M. de Bary (p. 244), are typical parasites in living plants containing chlorophyll; their complete development is dependent on their finding the living organism with its chemical and physical properties, which will afford a suitable host: most species are restricted, they can only grow in certain species or groups of species of plants, but not in others, a condition of things which holds good for parasites generally. This, says M. de Bary, does not exclude the possibility of bringing a parasite, by artificial nutriment, more or less forward. Practically to study all the ways of the parasite, whilst we are perfectly ignorant of the life-history of the host-plant in its native habitat, is certainly to put the cart before the horse—if the somewhat overstrained simile may be pardoned, it is rather like writing the life-history of the flea that

* A most excellent account of all that was known about this fungus, which was then called *Botrytis infestans*, was drawn up by the Rev. M. J. Berkeley in 1846, and published in vol. i. of the 'Journal of the Horticultural Society,' pp. 9-34; 25 pages of letterpress and 4 plates containing 30 figures showing the fungus and its allies in different stages.—J. G. B.

† 'Journal,' R. A. S. E., vol. xii. 1876.

lived on the man whose biography we desire but which has never been written. M. de Bary and Mr. Worthington Smith are not agreed on some essential points;* I must say I read only the other day the evidence before the Committee of the Commons in 1880 of the last-named authority with particular pleasure. I can afford to treat the fungoid theory lightly, because the responsibility is not with me; the grain of that theory, as will be seen in the sequel, the Commons Committee has sufficiently threshed out, weighed, and garnered: upon the scientific evidence, the Committee report that the nature of the potato-disease of 1845 consists in the growth on or in the plant of the fungus named *Peronospora infestans.*

M. de Bary is full of admirable candour; over and over again as regards these fungoid experiments he warns us against self-deception; he says of his *Pythium vexans* experiment, in which he had been working with tainted material, "without the greatest care one may be led into great error, and in this direction criticism ought to be applied" [p. 259]; again [p. 267], "the negative result caused me to doubt whether my previous explanation could hold good in the open field." With such complicated materials as living plants, with other fungi, namely, amongst others, *spicaria* † and *Fusisporium*, besides animal *infusoria* all about, and with sickly tubers, spores, and bell-glasses, "miniature gardens" and boxes without bottoms, "garden soils" and flower-pots all over the place, error could easily creep in and results very readily get mixed. M. de Bary's modestly-related researches, followed in many cases by purely negative results, have not touched to settle the questions, amongst others, of Hibernation and Host-plants. It is not so much M. de Bary himself as the school of De Bary which has dogmatically laid down this somewhat unfructifying proposition—there is no dispute as to the cause—all idea of other causes of the potato-disease of 1845 are excluded, because De Bary inoculated healthy plants; inoculation is defined as the introduction of a poison into a wound. Logically, this is drawing a very wide conclusion from very narrow premisses. If during eight years this experiment has not been repeated and confirmed by many persons in many places under varying and normal circumstances, I have, by way of argument, a perfect right to do so, and would very courteously question,

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* The principal point at issue between the two is that De Bary thought what he called *Pythium vexans* was a distinct organism, whilst Smith regarded it as a dimorphic form of the *Peronospora.*—J. G. B.

† *Spicaria* is a genus of moulds, but it has nothing special to do with potatoes. The three potato-pests are *Botrytis* or *Peronospora infestans, Fusiporium solani*, and *Sorosporium scabies.*—J. G. B.

not the entire good faith of the experimenter, but the sanitary condition and circumstances of the plants on which M. De Bary operated. The potato-fungus, it appears, is at least an impostor in this sense, it is not peculiar to the potato only, or even to that class of plants: M. De Bary says, "it is often found on other species of the *Solanaceæ*, and on other species not allied; it grows only in a stunted condition on the Dulcamara." Why stunted on the common Dulcamara of the hedges, because that plant grows under normal conditions; it has vitality and constitution, and is thus enabled to discourage or to cast off the parasite. The fungus appears on the *Lilium lancifolium* three weeks before the potato is affected.* It is stated that the stinging-nettle and the groundsel were liable to the curl, and whether or not to the parasite of 1845, I know not. It might, I think, be inferred from the pages of this 'Journal' † that the potato-fungus, the straw-fungus, and the clover-fungus are one and the same; but, if so, I am advised on high authority that any such proposition is absolutely inconsistent with the botanical knowledge of the day.

Of the habits and conduct of the wild plant in its natural habitat we know but little. Mr. Baker says "I have given in my Linnean paper all I know on this head." There are various clues leading to the idea that the potato is a social plant, that is to say, it desires association with another plant or plants of a different species. Lemmon found his wild potato in the Arizona under a tangle of prickly bushes and cacti; again, he found it flourishing under a squash vine. In Chili the best potatoes are cultivated in the rainy provinces of Chiloé and Valdivia, where the yield varies from 10 to 40 for one, the average annual produce being 3,100,000 bushels for the whole of Chili.‡ Inquiry should be pushed in the direction of the South American home of the plant: if you desired to study a Frenchman, you would visit his own grand country. You certainly would not hunt up a specimen at the Sablonière in Leicester Square.

The older writers talk of the plant as a creeper or trailing plant: and curiously through the centuries there have been constant attempts to force down the haulm into a creeping position: is this an instinctive desire to follow nature, and has constant cultivation too much drilled the potato out of its natural form into "heads up, soldiers"? The artificial bending down of haulm is to make it a conductor for diverting wet and

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* 'Journal,' R. A. S. E., vol. xix, 1858. Art. "Potato."

† 'Journal,' R. A. S. E., vol. x. p. 510. See also p. 515, 'On a new Clover Disease.' P. Mouillefert.

‡ Ency. Brit., Current Ed., Art. "Chili."

spores supposed to be carried by wet down the stem to the tuber.

Of the conduct of the plant in different countries, I can, beyond what has been said, glean but little: this might be a profitable line of inquiry. The wild Arizona potato, of which I have some specimens in my garden, is said to be palatable and nutritious. In India, I believe, the plant usually thrives; it is said it will not grow in Ceylon, except at Candy: why is this? Lemmon says, that when the first settlers went to Van Diemen's Land, one Samuel Bate took half a bushel of potatoes of a choice variety; to his surprise he found five varieties, which maintained their distinctiveness for years: afterwards, sent to a warmer climate, these degenerated and became again one sort.

Moulding-up or earthing-up, sometimes called Jensen's* system, after the learned Director of the "Bureau Ceres," Copenhagen, is, as I have shown, no novelty. "Mould-up—mould-up monthly or fortnightly," says an old writer in the 'Gentleman's Magazine' of 1764; and there are constant references to this practice through all the literature, some for and some against, as cutting the fibres: the famous old Scotch Judge, Lord Kaims, in his 'Gentleman Farmer,' 1798, was of this opinion. On the whole, earthing-up appears rather in favour than otherwise, but the importance of the practice should not be overrated.

As to practical cultivation, the reader will find this branch of our subject exhaustively treated in the 'Journal' of the Society,† and in the Report of the House of Commons Committee of 1880. The Royal Agricultural Society sent a paper of queries to all parts of Great Britain and Ireland, and the replies have been admirably arranged by Mr. Jenkins. These two Reports to their respective dates absolutely fix the existing systems: there you will find amply treated the practical questions of ridge or flat, ventilation and space;‡ the over distance which makes coarse, the narrowing in space which fines the tubers: early and late planting, manures, and varieties: these, and very many other considerations and details of cultivation which must be passed over here, are of the deepest interest to the practical cultivator. But before we turn from our practical retrospect from the farmer's standpoint to consider American experience, let me commend the following as the most practical of all

* Pamphlet, 'How to overcome the Potato Disease.' Edinburgh and Glasgow; Menzies & Co., 1882.

† 'Journal,' R. A. S. E., vol. x. 1874.

‡ 'Journal,' R. A. S. E., vol. xi. p. 395. 'Disease-proof Potatoes.' Mr. Carruthers' report on the results of the competition of 1874. The result of Mr. Maw's experiments gave only 2 square feet to each set.

practical considerations; cultivation means this,—that man, for his own purpose, steps in to bar the all-sufficient action of natural selection.

North American experiences are not very dissimilar to our own; I have consulted various Publications in the Library of the Royal Agricultural Society. The House of Commons Committee sought for American information, which for the most part the evidence failed to supply. In reports from the United States of America you may find the potato-bug (*Doryphora*) figured in all the "seven ages" of his life, with an account of his triumphal march from the Rocky Mountains northwards, "over hill, dale, and river:" having fed on the wild potato, he advanced to devour the cultivated crops. We read of the cultivated potato-plant as run out, and we are told potato-disease is as old as the potato: the writer holds the *Peronospora infestans* theory. Now an all-devouring louse, or aphis, appears on the scene to complete devastation. Next we are told that continued high cultivation has caused gangrene of the tuber, followed by a red-rust fungus, with an insect which lives only in the corrupted tuber. A writer in the Massachusetts Report of 1854 marvels at the universality of the disease, which is not occasioned by blight, insects, fungi, climate, or soils; the cause, over-cultivation, has always been the same, the effects varied. The cultivated potato has been subjected to a discipline more severe than that which any other plant has ever experienced: with abnormal culture the balance is lost, the leaves are diminished to encourage the tuber, the energies of the plant being withdrawn from its own nutrition; thus over-stimulation subjects to decay and climatic influences. We are ignorant of necessary conditions. I leave with regret a very thoughtful paper to take up another which introduces us to a little hard-shell worm, a wireworm, which in low lands effectually does its wicked will: next we find a potato-worm, which on the whole prefers tomatoes, but it is not very particular, and greedily falls-to on the potato—this is the tobacco-worm, when mature, the sphinx-moth. There is also another of the legion enemies of the solanum, the three-lined beetle, the *Lema trilineata*. Well might the American writer cry out for a theory that can account for all the phenomena, for a remedy to apply generally!

I have, in the Spanish language, publications from both sides of the South American continent, ably translated for me by my friend Major Stuart, late H.M. Minister at Hayti: I have had also an obliging communication in regard to the Peruvian authority from Colonel Jara Almonte, of the Peruvian Legation. Monsieur M. G. Merino, writing at Lima in 1878, treats of the epidemics of plants on the coasts of Peru; he says of the potato

(*S. tuberosum*), "It grows in its wild state on low hills; extensive cultivation was successful until the year 1867: the plant grew with an exuberance worthy of admiration, and disease in the nature of an epidemic was unknown. A local and transient disease had been observed, called '*Ceniza y tabaco*' (Ashes and tobacco), caused by a fungus rendering the leaves white as though dusted with ashes: another mould caused a snuff-dusted appearance: these diminished, but did not hinder production. Then in 1867 an epidemic appeared suddenly; it attacked the leaves only, leaving the tubers intact, and in all stages fit for food: the disease often runs its course in a single night. It is not parasitic; it is not impoverishment of the soil: the cause," says the writer, "resides in the atmosphere. In July 1867, a year of the greatest promise, in the last days of the said month there appeared in one night at daybreak two fields of earthed-up potatoes with their leaves completely withered: seen from a distance, there was a sombre black where previously there had been a cheerful green. We could not believe our eyes until we touched the reality. The failure was general, but not simultaneous; in all the valley of Lima the blight was most irregular, hit-and-miss, here a patch and there a patch. Later the virulence rather spent itself, and instead of one night the disease occupied in its work two or three days. The effect on the plants has been in proportion to the intensity and duration of the blight." The disease ran on unchanged until 1873, when "it was so bad it killed all the new varieties which had been obtained from California, Chincha, and Chili. Leafless plants were known to bud again, but only to die. Late-sown (August) potatoes gave a scanty yield: in the year 1877 even the potatoes planted near the sea were lost; these hitherto had the greatest power of resistance. Potatoes are blighted at every age, but suffer most when they have been earthed-up. Cloudy and rainy days are favourable, but above all things the blight appears to require moisture condensed on the leaves of the plants. During the second year, there was very dry weather until August, then drizzle, and the day of the blight, Saturday the 9th, towards night much rain. After this year the *lucerne-buds suffered excessively from the same disease:* simultaneously, in distant places, tomatoes also were attacked. Sometimes the disease begins with isolated patches of various size on the margins of leaves of the colour of tobacco, with a whitish border, then the ultimate fate of that field is sealed." The writer combats the mould theory, on the ground that all vegetable tissues in decomposition are thus attacked. "All experiments, and experiments have been numerous, have failed: sulphur-smoke once succeeded, but it is not clear how it acted: artificial irrigation greatly aggravates:

change of seed and of season, seed even from France, are the only means adopted of which, though doubtful, we can speak at all favourably. The variety that runs the most risk is that which is most commonly planted: there comes from Peru a far cry for a disease-resisting variety, and the expression of a belief in individual plants, or varieties of superior vitality."

On this account Dr. Cooke, of Kew, author of the 'Handbook of British Fungi,' observes: "I think that the paper should be published. The disease exhibits symptoms of a fungoid disease. The great deficiency is the want of a microscopic examination of infected parts, or specimens, either dried or in fluid, which should have accompanied the account. It would be worth while making an effort to obtain specimens of infected plants in order that they may be submitted to the microscope." Query: Is it after all our "potato disease" imperfectly described?

Turning now from the west to the east coast of South America: in the 'Manual Cultivador Americano,' published at Monte Video in 1882, there is an article on the 'Potato,' from which the following is an extract:—"The tendency to degeneration of the infinite varieties is about the first thing noticed. The potato yields in field cultivation two easy crops every year: the potatoes are planted in August, February, and March; and gathered in December and May and June. The potato from seed is a means of regeneration. A disease which parches and burns the haulm, appeared in the years 1856–7, devastating all our fields. We tried various experiments, and tried amongst others one which in an extreme case was efficacious, and by which we were enabled to save sound tubers for seed: we grafted the tomato near the ground, in the stalk of the potato, and thus obtained sound tubers, nourished by the tomato, from which we likewise obtained produce. This result is, of course, more curious than generally useful." After suggesting known means of supposed preservation, the writer goes on to mention the ravages of the wireworm, which nests and breeds amongst the tubers, and increases prodigiously in time of drought.

"A report to the 'New York Tribune' states that the potato crop of Western New York, and probably that of the State, is threatened with a disease. The vine is attacked with 'black rust,' which is first noted by brown spots on the margins of the leaves, shrivelling the entire plant as it spreads. The rapid extension of the disease, and the decay of the leaves and stalk, follows as soon as the foliage dries up, and the potato itself becomes affected and decays. A large number of potato-growers, who were anticipating an abundant yield, now foresee an almost complete destruction of this crop. The cause is attributed to the moist and unusually cloudy summer. Fields

upon the bottom lands have been the first to wither away. The potatoes in the hills under many healthy vines, when cut open, are also found rotten at the centre from wet." *

Before taking leave of the vast Continent of America to consider home investigations in our own House of Commons, I beg leave to acknowledge, from the author, Mr. Lemmon's very interesting account of the "Discovery of the Potato in the Arizona," a paper read before the California Academy of Sciences, San Francisco, on January 15, 1883. I have, as previously mentioned in my own garden, a plant or two of this potato, *S. Jamesii* of Torrey, and also the *S. Maglia.*† The Arizona country I take to be about lat. 33° N. I have quoted Mr. Lemmon in several places; I should here mention further that I gather from p. 8 that *Maglia* has a double signification; it is the recognised botanical name of a known species, and also the Chilian native name for the wild bitter potato as distinguished from the long-cultivated varieties which generally they call "Pogny." Mr. Lemmon, under the local designation—as "of England"—flatters me by a mention of my name and of my known interest in the subject: he mentions also the Royal Agricultural Society and our ninety-four essays in 1872, none of which solved the difficulty, but most of the writers were agreed as to the underlying cause—degeneracy. Mr. Lemmon says further—the best American cultivators are of opinion that long cultivation of the potato with unchanged conditions results in weakness of the constitution, followed by disease, decay, and dissolution.

The scientific and practical aspects of the subject are absolutely fixed to that date by the evidence collected, and by the Report of the House of Commons Committee of 1880. The nature of the potato-disease of 1845, according to the evidence, consists in the growth on or in the plant of a fungus, *Peronospora infestans.* There is a conflict of testimony as to whether the fungoid or mouldy devastation was then introduced, or whether it previously existed in a modified form, and was rendered virulent by exceptional weather. All the witnesses concur in a necessity for the production of new varieties; ‡ all

* 'Morning Post,' Sept. 25th, 1883.

† I have given my little stock of tubers to Messrs. Sutton of Reading, as their collection of cultivated types in a living state is said to be the most complete in existence. I am promised that the different species shall be as perfectly hybridised as possible.

‡ Mr. Thistleton Dyer, F.R.S., Assist. Director, Royal Gardens, Kew, one of the witnesses in question, has done me the favour to make the following note on my proof. "I doubt this, but I do not doubt the possibility (not necessarily practicability) of eventually getting disease-resisting kinds." Mr. Dyer's idea is that in this paper we lay too much stress on the consequences of deterioration.

potatoes have deteriorated in their disease-resisting powers: a variety from seed takes four to six years for its real establishment, and then under the most favourable circumstances a good variety might be expected to degenerate in twenty years: the production of new varieties is of national importance.

Six millions of money, according to the Registrar-General, eight millions, according to Professor Baldwin, was the loss from potato-disease in Ireland alone in the one year preceding the inquiry, namely in 1879. It is impossible here to sum up the interesting evidence; it should be studied, and students must draw their own conclusions. There are, however, a few points on which I would touch lightly: the biography of the potato-mould or fungus is treated exhaustively; it is of its kind similar to the common mould which attacks damp and decaying vegetable substances: the potato-mould differs in inflicting mortal injuries on a living plant. If you take plants and animals generally, you never find parasitical growth in a perfectly healthy condition; throughout the whole of nature parasitical growth attacks the feeble. Ravages are due to sudden climatic conditions fitted for the germination of the hovering and omnipresent seeds or spores: all epidemics are subject to sudden acceleration. The potato "murrain" is compared to blood-poisoning in animals, and the analogy holds:* Given the condition to invite the growth of mould, be it a cheese or be it a potato, there, hovering, are the spores or seeds, and they are

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In his opinion, the principal mischief in the case of the potato, as in other cultivated plants, arises from the fact that we grow in great masses species that in nature are scattered about in different habitations."

* Darwin observes ('Origin of Species'): "Analogy may be deceitful—yet all living things have much in common: chemical, cellular, laws of growth, liability to disease and injury." "Living bacteria," says Beale ('On the Microscope,' 5th Ed., 1880), "originate in decomposing matters . . . . living bacteria, like other living things, come from germs formed by pre-existing living things like themselves." "Bacteria," says Hogg ('On the Microscope,' last Ed., p. 749), "with omnipresent spores produce ferments in the animal body . . . . splenic fever, for example, attacks horses, cattle, sheep, rodents, and even man; bacteria multiply to swarm in the blood, and in a few hours death supervenes." Dr. Koch, Chief of the German Cholera Commission, reports, under date, Jan. 7th inst. Something like the discovery of specific cholera *bacilli*—"If," says the doctor, "*bacilli* of a specific character are exclusively incident to the process of cholera, the original connection between the appearance of these bacteria and the disease would scarcely admit of any doubt."—['Times,' Feb. 16, 1884.] "The discovery by Dr. Koch and his colleagues, of cholera *bacilli* in a tank in the Baliaghatta suburb of Calcutta, which has already been telegraphed to the 'Times,' has excited much interest here, and is clearly a great step forward in medical science. The chain of evidence, however, connecting these *bacilli* with the cause of the disease is not yet complete. The German doctors have proved that this organism exists in all cases of cholera, but in no other disease; that it has been found in a tank used by the people among whom the disease appeared, and that it diminished in numbers as the disease died away. But they have still to show whether the *bacillus* is the cause or the result of cholera."—'Times,' Feb. 25.

ready to pounce: where the carcass is, there are the eagles gathered together.

Concerning the conflict of evidence referred to in the Report of the Committee as to whether the mould peculiar to the potato and kindred plants did or did not exist in these islands previous to the year 1845, I myself entertain no manner of doubt; my instincts, the analogies, the probabilities, the evidence now in question, and all my reading of authorities of this century and the last, lead me to believe with that portion of the expert evidence which says, in effect, that the mould in question is in connection with it as old as the potato; only until comparatively recent times men had not for common things such microscopic eyes.

The evidence further tends to show that our knowledge, whilst tolerably complete as to the mould, is altogether insufficient in regard to varieties of the potato-plant, and to their disease-resisting capabilities. We are also said to be much in want of cultural results.

We are told how important it is to keep up the physical condition of the plant by proper food and manure, and proper and sufficient space. Potatoes are overcrowded, they are treated alike on all soils, high and low, dry and marshy. The mould in question, it is observed, also attacks various wild plants, as the *Solanum dulcamara*, the bitter-sweet of our hedges; but these being healthy, hardy, and to the manner born, consequently natural to the soil and climate, throw off the attack with ease, and rarely succumb; hardy native and uncared-for subjects escape, whilst imported and cultivated plants degenerate and perish.

I wish to direct the attention of practical growers to the following suggestions which arise on the Parliamentary evidence, and are supported by independent evidence received by me from home and foreign correspondents. The suggestions relate to the conduct of the potato-plant in its social relations with other plants; on this point I think it is Liebig who observes, in effect, that the struggle for existence of kindred plants is far more severe than that between individuals of different species. It has been observed that in alternate rows with beans, potatoes have been remarkably free from disease: again, volunteer crops, that is, potatoes in the second year growing spontaneously with other crops, as corn or turnips, are said to be absolutely free from disease.

In taking leave of the Report and Evidence of the Commons Committee, we may, in conclusion, gather that, as regards the cultivated potato, there is no natural selection; Nature is not free to act in her own way, so judgment in selection is abso-

lutely necessary: as to cultivation, we must "hark back" to a more natural system: we want careful studies of varieties, and we want new varieties.

In the House of Commons, the Chancellor of the Duchy of Lancaster was asked by an honourable member whether proposals had been received from the Highland and Agricultural Society, in conformity with the recommendations contained in the Report of the Select Committee on the Potato-crop, 1880—namely, to undertake, with the pecuniary assistance of the Government, a series of experiments with a view of producing new and disease-proof varieties; and whether those proposals had been favourably considered.

Mr. Dodson said that Lord Carlingford and himself had been interviewed on this subject, but in the matter they did not see their way to granting any pecuniary assistance from the State.

In consequence of the question, I immediately wrote the following letter to the right hon. gentleman, and my further object in this Paper is simply to explain that communication, and to add to it only such further observations as may appear absolutely relevant and essentially complementary.

SIR, London, June 23rd, 1883.

I write to you in regard to the disease in the cultivated potato, and in reference to your reply in the House last evening.

I do not in any way question the decision at which you have arrived; Government aid to an inquiry off the true line would be a misfortune.

I should explain that the accident of my being President of the Royal Agricultural Society of England during the last serious outbreak induced me to offer a prize for an Essay on the subject of the Potato-disease. The necessary conditions were published by the Society, and this brought me communications from all parts of the world. The subject, moreover, has for me a sort of fascination, being of its kind the most economically important and apparently insoluble problem of our day.

For ten years this subject has more or less occupied my thoughts; I have traced the history of the plant from the first; I have noted many facts, and in my own mind I have reached certain conclusions. My evidence, arguments, and conclusions, I hope some day to embody in a paper for the 'Journal of the Royal Agricultural Society.'

Meanwhile my object is to mention to you, and to ask you to convey to any interested in extensive experiments, that it might be desirable to communicate either with my friend, Mr. J. G. Baker, F.R.S., Royal Herbarium, Kew, or with myself.

Mr. Baker's position as a man of science, his residence and official duties at the headquarters of English botany, together with a longstanding acquaintance—he was a neighbour in Yorkshire—induced me recently to seek his aid. Being in possession of my views, he has brought his clear, instructed, and altogether unprejudiced mind to bear on the inquiry. Mr. Sutton, of Reading, has for the purposes of study kindly placed his very extensive potato-grounds at our disposal, and, subject to verification, this crop, the result of our inquiry, appears something like the *discovery* of reliable bearings from whence to take a safe departure.

In due course this communication was courteously acknowledged.

Government aid I do think may be fairly sought for in the following direction. After years—a century—of inquiry, sharpened by economic disaster and human misery and starvation, science cannot answer my query—What is the conduct of the potato-plant and its circumstances as regards its neighbours, and the other surroundings of its natural habitat? I take up the 'Admiralty Manual of Scientific Inquiry,'* and find inquiry suggested in South America and elsewhere: sarsaparilla, balsam of copaiva, ipecacuanha, and the milk- or cow-tree of Para—which tree, in case of the continuance of "foot-and-mouth" disease, might prove a godsend to the nursery—but not one single word of anything so common as the everyday potato. H.M.S. 'Alert'† has been on a cruise in those waters. "The cocoanut industry," we are told, "has recently fallen off, owing to the ravages of a worm, and the old spice industry has been revived;" not a word of the anti-scorbutic—the modest potato. Then every one is not a Darwin, and the authorities were certainly not on the 'Alert.' Yet there might be alertness on the part of Government—the Government of a nation that boasts of ships on every sea: some ship of the South Pacific squadron, some 'Alert' having a competent man on board, scientifically equipped with an opera-glass and a sketch-book, might some fine day take a summer cruise round the Chonos Archipelago; and if this competent man were not exactly a Darwin, he might, as much as possible, endeavour to resemble that pre-eminent philosopher.

My first letter to Mr. Baker was dated on June 1st, 1883, and was to this effect: after reference to comparatively the very little the 'Journal' tells us on the subject in question, I went on to say: I hold the disease in the cultivated potato is a conjugation of the verb "degenerate:" I hold that, if nature were free, the whole of the cultivated potato would be killed off, excepting only perhaps a few chosen plants, left to replenish the European branch of the potato family; or perhaps the law of extinction would have full force and effect. I understand it is a fact that the potato in Europe has never grown spontaneously.‡ The importance of the whole subject is hardly realised: we have within the three kingdoms some 1,400,000 acres annually, which at only 10*l.* an acre represents a huge

* Published by authority of the Lords Commissioners of the Admiralty for the use of officers of H.M. Navy and travellers in general. John Murray, Albemarle Street, London.

† 'Cruise of the Alert; four years in Patagonian, Polynesian, and Mascarene Waters.' By R. W. Coppinger, M.D. London: Sonnenschein and Co. 1883.

‡ 'Ency. Brit.,' current Ed., Art. "Acclimatization," which see.

sum. Now for my special difficulty. I cannot find any sufficient study of the potato-plant in its natural habitat. Humboldt merely just mentions its growth: Darwin, in his voyage round the world—Chonos Islands, lat. 45°—mentions great abundance in sandy, shelly soil near the beach, some plants four feet high: the tubers have the same smell and appearance as the English potato. Darwin goes on to remark that "the same plant is found on the sterile mountains of Central Chili, where a drop of rain does not fall for six months, and within the damp forests of these southern islands." Now all this is not enough for my purpose: I want a careful study. Does the plant grow in large clumps, or in single families, interspersed with other vegetation? if so, the nature of any such vegetation with which the potato lives in friendly cohabitation; and a thousand other facts which will occur to your trained mind should be known. This is a principle of mine evolved for the purposes of the present inquiry—the more artificial the condition, the more necessary it is to couple nature with freedom, and to study this combination, with a view to all possible conformity.

I have made an unworthy precis of the interesting letters I received from Mr. Baker, under dates from June 4 to December 27, 1883.

Mr. Baker sees no reason to doubt the conclusions stated as to the disease and degeneracy of the potato-plant; * the life-history of its parasitic fungi has been fully investigated, they would not attack the plant if it were grown under normal conditions. The question asked, what are the normal conditions? is a fair and proper question to put to a botanist, but a very difficult and complicated one to answer. The universally accepted botanical authority † on the subject gives some twelve or fifteen species closely allied to the cultivated potato: it stands to reason the climatic requirements of these several species, widely distributed over a vast continent, must be exceedingly different. Yet their botanical differences are small, and their relationship to one another and to the cultivated potato have never been adequately investigated. In regard to the extract cited from Darwin's voyage of the 'Beagle,' in which he gives an account of the potato growing wild in the Chonos Archipelago, off the coast of Patagonia, where the climate is very damp and equable, I have examined Darwin's original specimen, and I am quite satisfied that the plant is not *Solanum*

* Mr. Thistleton Dyer, F.R.S. [see ante, p. 291], notes, "I take it the reason the potato mould is so powerful is, that we grow the potato in large areas—Nature does not; we put our eggs, at any rate, large parcels of them, into one basket—Nature knows better!

† Monograph by Dunal in the 13th volume of 'De Candolles Prodromus.'

tuberosum, but *S. Maglia*, which differs as much from *S. tuberosum* as any of the species. *Solanum tuberosum*, from which the cultivated potato is considered to originate, is said to be a plant of the High Andes of Chili, and surely a plant of the sterile mountains of Central Chili, where a drop of rain does not fall for six months, and where, as compared with the northern hemisphere, summer and winter are reversed, is grown in England, Scotland, and Ireland under such abnormal conditions, that it is not surprising it degenerates and becomes diseased. Far more confidence might be placed in *S. Maglia*, of which the geographical requirements resemble our own. When they come into flower I would like to compare the leading kinds of the potato grown in England with each other and with the wild types; with that view, I will write at once to Mr. Sutton, I should go through his fields to see as many varieties as possible, and carry away ten or a dozen good specimens of the leading types for study. De Candolle, otherwise admirable, confounds *S. tuberosum* and *S. Maglia*, as does Sabine, who is otherwise at the foundation of our potato knowledge. I send you some *S. Maglia* tubers to plant. Your notes have been read; I think we may classify matter bearing on the subject under four heads: (1) History of the cultivated plant; (2) Its diseases, parasitic fungi, and parasitic insects; (3) Its botanical geography; (4) Its physiology. Subjects 1 and 2 are almost exhausted; 3 and 4 comparatively neglected; 3 is the branch on which I am specially at home. I think we may formulate a general principle such as this: every species has a certain range of power and adaptability as regards soil and climate. If the conditions which it needs are not supplied, it will degenerate, become diseased, and finally die out. You can only acclimatise in a new country by giving what is required in the matter of soil and climate: there is here a wide field for research and experiment. Touching subject 4, see the best Paper that has been written on the physiology of the plant, that of T. A. Knight, 'Philosophical Transactions' for 1806. No doubt one powerful cause of deterioration in the potato is that the tuber has been abnormally stimulated * at the expense of the rest of the organism. A familiar English name for *S. Maglia* would be "Darwin's Potato."

Messrs. Sutton were most kind and hospitable; we have spent some time in their trial-grounds (August 11), and have obtained many specimens and made many notes. All the information to be obtained about the species and their climatic

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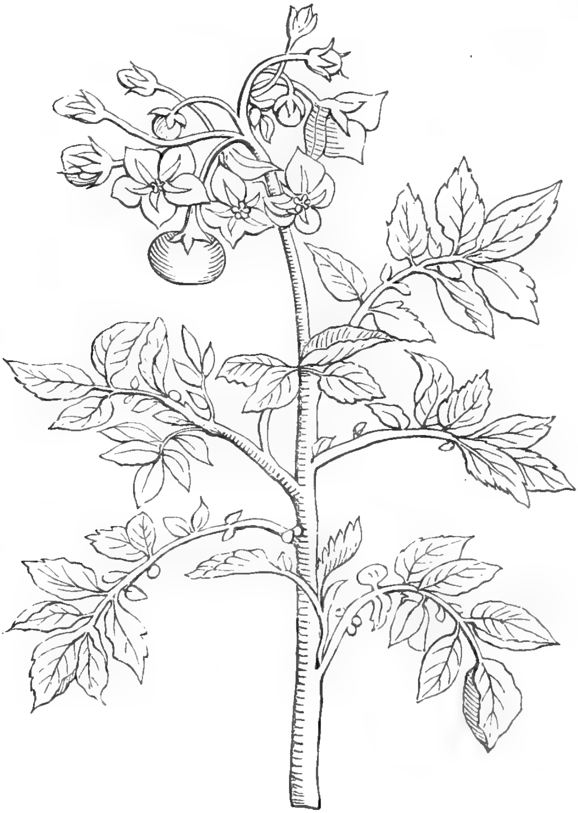
* Mr. Thistleton Dyer, F.R.S., notes: "I doubt this; the Irish Government got over a fresh strain from South America and it suffered just as much as the abnormally stimulated varieties."

range I have brought together in the form of a paper for the Linnean Society; it is illustrated by drawings of each of the five distinct specific types: the paper will not be printed *in extenso* for some months. Meanwhile please use my summary of

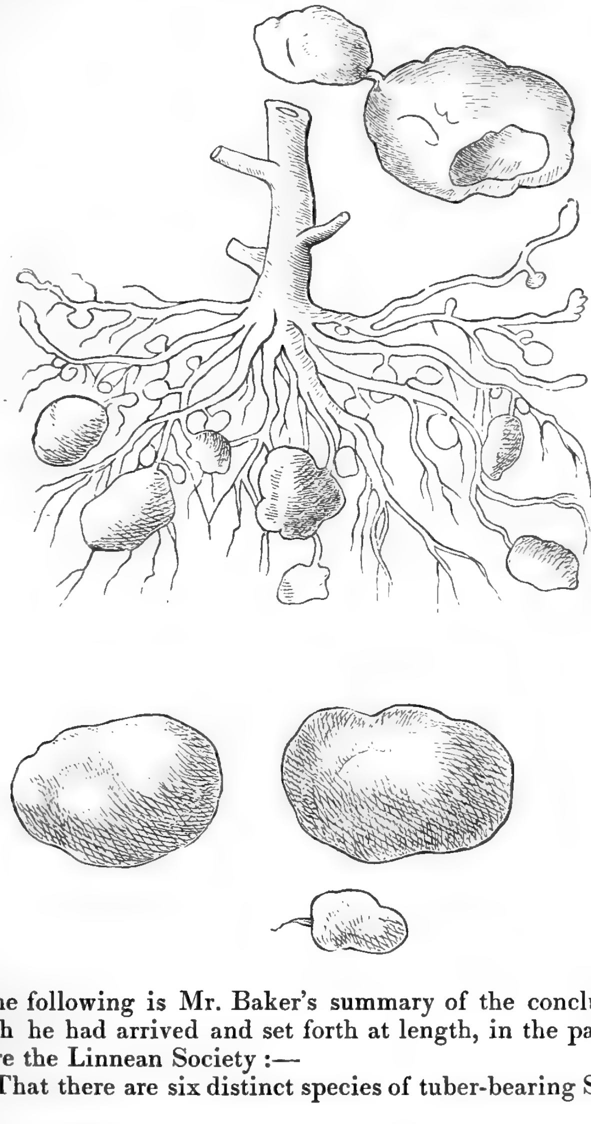
Fig. 1.—*Haulm, Flower, and Berry of* Solanum tuberosum, *from the Plate of Clusius (de l'Ecluse) mentioned by De Candolle, and published in the year* 1601.



conclusions in any way you wish. The different accounts do not agree as to the sort of place the wild potato grows in; the accounts are so contradictory, from them safe conclusions cannot be drawn: the Linnean Society paper * cites all the obtainable testimony.

* "Cultivators work on the tacit assumption that the one object in life of the potato-plant is to grow potatoes, and this assumption has no sound foundation in fact or reality."—Mr. Baker's 'Linnean Paper.'

Fig. 2.—*Tubers and Root-fibres of* Solanum tuberosum, *from the same Plate as* Fig. 1.



The following is Mr. Baker's summary of the conclusions at which he had arrived and set forth at length, in the paper read before the Linnean Society :—

"That there are six distinct species of tuber-bearing Solanum, viz. :

"1. *S. tuberosum*, with many varieties, extending as a wild plant from Chili to the Rocky Mountains ; climate always cool, equable, dry.

"2. *S. Maglia*, wild on damp coasts of Chili.

"3. *S. Commersoni*, wild on lowlands of Uruguay, about Montevideo.

"4. *S. cardiophyllum*, wild in highlands of Central Mexico.

"5. *S. Jamesii*, wild in Rocky Mountains.

"6. *S. oxycarpum*, wild in Central Mexico.

"All the cultivated forms owe their origin to *tuberosum*, but Darwin's plant and that experimentised by Sabine, are not *tuberosum*, but *Maglia*. Deterioration of potato may, no doubt, be traced to two sources—too much of its vitality being thrown into the tuber at the expense of other parts of the plant, and its being grown in unsuitable climates (*i.e.* countries damper and warmer than its native home).

"There is a wide field open for further experiment in cultivating species 2, 3, and 4, and hybridising them with *tuberosum*. *Maglia* would no doubt bear damp, and *Commersoni* (*Ohrondii*) warmth better than No. 1. The potatoes of *Jamesii* and *oxycarpum* would no doubt be too small to be of any practical use.

J. G. BAKER."

VII.—*Report on the Competition for Seed Wheat*, 1883. By WM. CARRUTHERS, F.R.S., Consulting Botanist to the Society.

SOME years ago the Council endeavoured to direct the attention of seed-growers and agriculturists to the production of new varieties of wheat, in the hope of improving the quality and quantity of our wheat crops. Two sets of prizes were offered: one to be competed for at once, and intended to bring out any new varieties still in the hands of their producers; and the other was deferred till the autumn of 1882, so as to give time and opportunity for the production of new varieties.

The prizes were offered for distinctly new varieties, which should combine the largest yield of grain and straw per acre, with approved form and size, smooth and thin skin, full and white kernel, and high specific gravity in the grain, and light, firm, and stiff straw.

The results of the competition in 1879–80 were published in the Society's 'Journal,' vol. xvii. of the second series.

The date for sending in samples for the second competition was the first day of October, 1882, and there were then delivered two samples of white wheat. Each sample was divided into four equal portions, after a small quantity had

been reserved for comparison, and each portion was to be cultivated in one of four localities in England differing in soil and climate, and the prize was to be given to that which showed the best results, if the Judges considered that the winning variety possessed qualities which entitled it to distinction.

The characteristics of the competing grains are described by their respective owners as follows:—No. 1 was sent in by M. Henry Vilmorin, Verrières le Buisson, Dept. Seine et Oise, France, under the name "Dattel Wheat." It was described as having a white, large, and full grain, a beardless ear, broad and of medium length, red or brown chaff, and a white straw of medium height and very strong and stiff. It was raised from a cross effected purposely between "Blé Chiddam d'automne à épi rouge" and "Blé Prince Albert," in 1874. About a dozen plants were produced from as many fertile seeds, the best seed only was kept, and when the variety was well fixed it was called "Dattel wheat." It bears some resemblance to "Blé Chiddam a épi rouge," but is superior in every respect to that variety. The seed sent for competition was grown at Verrières. No. 2 was sent in by Messrs. James Carter and Co., 237, High Holborn, London, under the name "Seedling White Wheat—Carter's No. 1." It was described as having a plump grain of fine quality and colour, and thin skin; a close-set grain, not liable to thresh during windy weather; and a stiff, long, firm, and bright straw, which does not layer in wet weather. This wheat was selected by Messrs. Carter some two or three years back, from a red variety raised by Mr. Wilkin.

The samples were carefully weighed and measured before they were sent from the Society's office. The weight per bushel of No. 1 was 61½ lbs., and of No. 2, 62¾ lbs.

The gentlemen who undertook to grow the experimental samples on the previous occasion were good enough to undertake the trials again. The samples were accordingly sent to Mr. James Edwards, of Woodhorn Manor, Morpeth, Northumberland; Mr. Charles Randell, of Chadbury, Evesham, Worcestershire; Mr. James Rawlence, of Bulbridge, Wilton, Wiltshire; and to Mr. W. J. Malden, the manager of Crawley Mill Farm, Woburn, Bedfordshire—the farm placed by the Duke of Bedford at the service of the Society for experimental purposes. These localities fairly represent the different climatic conditions of the wheat-growing districts. The soils also were varied; it was a stiff boulder clay at Mr. Edwards's farm, an open clay at Mr. Randell's farm, a thin soil resting on the chalk at Mr. Rawlence's farm, and a very light sand resting on sand at Crawley Mill Farm. Each grower received 46 lbs. of the first variety, and 47 lbs. of the second variety, and a peck

of the original sample was set aside for comparison with the products of the following harvest.

The samples were sent to the growers early in November, 1882. At Crawley Mill they were sown on the 14th of November, at Bulbridge on the 22nd of the same month, and at Woodhorn Manor on the 27th of November, while Mr. Randell did not sow his portion at Chadbury till the 27th of February, 1883. The particulars of the weight sent as reported by the growers, the quantity sown, the extent of the land on which each variety was grown, and the date of the sowing, are given in Table I. on the opposite page.

The differences in the quantity of seed employed by the growers deserves to be noticed, and is most apparent in the columns that specify the weight and the quantity per acre. The largest quantity was used by Mr. Rawlence. His soil forms only a thin covering on the surface of chalk, which, being a porous rock, acts as a natural drain. It is consequently necessary, as I pointed out on a former occasion, that the cereal crops should be thickly sown, as Mr. Rawlence always does in order to cover his soil with a thick crop of green, and so prevent the evaporation of the moisture from the soil. The difference between the practice of Mr. Rawlence in Wiltshire and Mr. Malden in Bedford, in the quantity of seed employed, is so great, that Mr. Malden puts on three acres what Mr. Rawlence found necessary for two. Mr. Malden, that is to say, saved a bushel and a half on every two acres, as compared with Mr. Rawlence—a saving of not a little importance in economic farming.

Mr. Randell did not sow till the spring. The samples were received too late to be planted in October, and the state of the weather after that month rendered wheat sowing impossible until the end of February. The 27th of February was the first day that the land would bear the horses, and the wheat was then sown, the remainder of the field being planted at the same time with "Essex rough chaff." The land is a strong loam upon clay, in good condition, having grown in 1882 vetches eaten off by sheep with oilcake, followed by cauliflower, the heads of which were cut and carried off, and the leaves were eaten by sheep again getting oilcake. The field was uniform in quality and condition, and the three crops were treated precisely alike. All the crops stood up well, and were free from mildew. At harvest the crop of the whole field was as good as any of the autumn-sown wheat. So that, in Mr. Randell's opinion, the experiment was not in the least modified by the spring sowing.

Mr. Rawlence sowed his samples on the 22nd of November, and the remainder of the field was sown at the same time with

TABLE I.—QUANTITY of SEED SOWN and AREA of EXPERIMENTAL CROPS, with DATES of SOWING.

	"DATTEL WHEAT."						"SEEDLING WHITE WHEAT."					
	Quantity Sent.	Quantity Sown.	Area of Land Sown.		Rate per Acre.	Date of Sowing.	Quantity Sent.	Quantity Sown.	Area of Land Sown.		Rate per Acre.	Date of Sowing.
	lbs.	lbs.	Roods.	Poles.	lbs. bush. pks.		lbs.	lbs.	Roods.	Poles.	lbs. bush. pks.	
Mr. Rawlence	46	46	1	13	134 — 2 $0\frac{2}{3}$	Nov. 22	47	47	1	13	142 — 2 1	Nov. 22
Mr. Randell	46	45	1	28	106 — 1 3	Feb. 27	47	46	1	32	102 — 1 $2\frac{1}{2}$	Feb. 27
Mr. Malden	46	45	2	0	90 — 1 2	Nov. 14	47	46	2	..	92 — 1 2	Nov. 14
Mr. Edwards	46	46	2	0	92 — 1 2	Nov. 27	47	47	2	..	94 — 1 2	Nov. 27

"Square-head Wheat," the three plots being cultivated under the same conditions.

Mr. Malden sowed his samples on the 14th of November, his ordinary crop, "Browick Wheat," having been put in the ground on the 23rd of October. The land on which the competition-samples were grown is a very light, loose sand, with a sandy subsoil. This piece of ground was chosen because it was the only piece available that was sufficiently uniform in its soil to give trustworthy results. It was, however, much overrun with poppies and mare's tail. The previous crop was cabbages, which were intended to have been fed off on the land, but, as they were late and not fit to consume, they were carted off, and the land consequently left in a very poor condition. Ten tons of dung were applied to the acre, and the wheat was dibbled in. It came up well, but was attacked by a small white grub, which thinned the plant; and though it showed well in the spring, there was only about three-quarters of a plant on either crop. The birds were troublesome as the wheat began to ripen, for this was the earliest piece of corn in the neighbourhood.

Mr. Edwards sowed his samples on November 27th. The soil was a strong loam of considerable depth, and uniform throughout the plots on which the competition-samples and his own crop were sown. The field is nearly level, and is well drained. The land was in good condition. A heavy crop of swedes had just been carted off. They had received a dressing of 25 loads of foldyard-manure, and 4 cwt. of mineral superphosphate to the acre. The weather had prevented the swedes being removed till very late in the season. The land then received one furrow, and the wheats were carefully sown broadcast by hand, on two parallel half-acre crops, and the ordinary crop, "White chaff Red Wheat," was sown on a third similar plot, through which, however, there was a public footpath. The land was rather damp at the sowing; a single with the harrow was given that day, and a double across the next. There was very little show of plant on any of the plots through the winter and spring. M. Vilmorin's "Dattel Wheat" took the lead at first, having the best colour and strength of flag, but the ordinary crop was most promising as harvest approached. The appearance of Carter's "Seedling White Wheat" did not give promise of such a good crop as it turned out. They all ripened at the same time. They had been very much laid and tangled by the strong wind and rain. Carter's "Seedling White Wheat" was least injured, and had consequently the advantage at harvest. The cutting was a difficult and untidy job, and a good deal both of the straw and grain was left on the ground.

The dates of cutting varied. Mr. Rawlence, in the south of

Hampshire, cut the plots on the 15th of August; three days later the crop was cut at Woburn; while Mr. Randell's plots were not cut till the 4th of September; and Mr. Edwards's, in Northumberland, not till the 12th of that month. The results of the cultivation are tabulated in the following Tables.

TABLE II.—YIELD in GRAIN and STRAW and VALUE OF PRODUCE.

	Grain.								Straw.							
	Weight.					Value.			Weight.	Value.			Total Value.		
	Per Bushel.		The Produce.												
	Best.	Tail.	Best.	Tail.	Total.										
	lbs.	lbs.	lbs.	lbs.	lbs.	£	s.	d.	lbs.	£	s.	d.	£	s.	d.
"DATTEL WHEAT."															
Mr. Rawlence	63	52	756	46	802	3	15	6	1512	1	7	0	5	2	6
Mr. Randell	60½	54	1156	65	1221	5	10	2	1596	1	8	6	6	18	8
Mr. Malden	60	42	697	18	715	3	0	0	1570	1	1	3	4	1	3
Mr. Edwards	59	42	912	14	926	3	6	10	1260	1	5	0	4	11	10
"SEEDLING WHITE WHEAT."															
Mr. Rawlence	62½	58	812	89	896	4	1	4	1540	1	7	6	5	8	10
Mr. Randell	60	56	1114	127	1241	5	7	8	1624	1	9	0	6	16	8
Mr. Malden	62	44	804	44	848	3	10	3	1561	1	1	0	4	11	3
Mr. Edwards	59	44	1144	24	1168	4	8	11	1484	1	10	0	5	18	11
THE GROWER'S OWN CROPS.															
Mr. Rawlence	63½	49	984	43	1027	4	4	3	1316	1	3	6	5	7	9
Mr. Randell	60½	56	1119	108	1227	5	13	4	1652	1	9	6	7	2	10
Mr. Malden	59	51	1182	188	1370	5	7	0	2800	1	17	6	7	4	6
Mr. Edwards	58½	40	1041	37	1078	3	17	7	1470	1	10	0	5	7	7

The estimates of the value of the grain and straw were supplied by the growers. They are based on the local market values. (No. II.) The value of the results will be more apparent from the next Table (No. III. p. 306), in which the produce and value of the wheat per acre have been worked out and tabulated. The crops were nowhere exceptionally good. The very

TABLE III.—SHOWING the PRODUCE and VALUE of WHEAT and STRAW per ACRE.

	"Dattel Wheat."					"Seedling White Wheat."					Grower's own Crop.				
	Grain.		Straw.		Total Value.	Grain.		Straw.		Total Value.	Grain.		Straw.		Total Value.
	Weight.	Value.	Weight.	Value.		Weight.	Value.	Weight.	Value.		Weight.	Value.	Weight.	Value.	
	lbs.	£ s. d.	lbs.	£ s. d.	£ s. d.	lbs.	£ s. d.	lbs.	£ s. d.	£ s. d.	lbs.	£ s. d.	lbs.	£ s. d.	£ s. d.
Mr. Rawlence	2421	11 8 0	4564	4 1 0	15 9 0	2705	12 5 6	4838	4 6 6	16 11 0	3100	12 15 1	3973	3 11 0	16 6 1
Mr. Randell	2873	12 9 1	3755	3 7 0	16 6 1	2758	11 12 7	3609	3 4 0	14 16 7	3020	14 1 8	4066	3 12 6	17 14 2
Mr. Malden	1430	6 0 0	3141	2 2 6	8 2 6	1696	7 0 6	3122	2 2 0	9 2 6	2742	10 14 0	5600	3 15 0	14 9 0
Mr. Edwards	1952	6 13 8	2520	2 10 0	9 3 8	2336	8 17 10	2968	3 0 0	11 17 10	4662	17 15 8	2968	3 0 0	23 15 8

small yield of the competing crops on the Woburn Farm, as compared with the yield of the Browick wheat, the ordinary crop of the farm, is due mainly to the better quality and condition of the stack-yard field on which the Browick wheat was grown. The competing wheats were sown on a poor field, which, as it afforded an even character throughout, was thought

TABLE IV.—The AMOUNT and VALUE of the PRODUCE of the CROPS of each GROWER.

	Grain. Weight per Bushel. Best.	Tail.	Weight of Produce. Best.	Tail.	Total.	Value. £	s.	d.	Straw. Weight.	Value. £	s.	d.	Total Value. £	s.	d.
	lbs.	lbs.	lbs.	lbs.		£	s.	d.	lbs.	£	s.	d.	£	s.	d.
Mr. Rawlence.															
Dattel	63	52	756	46	802	3	15	6	1512	1	7	0	5	2	6
Seedling White ..	62½	58	812	84	896	4	1	4	1540	1	7	6	5	8	10
Square Head, ordinary crop	63½	49	984	43	1027	4	4	3	1316	1	3	6	5	7	9
Mr. Randell.															
Dattel	60½	54	1156	65	1221	5	10	2	1596	1	8	6	6	18	8
Seedling White ..	60	56	1114	127	1241	5	7	8	1624	1	9	0	6	16	8
Essex Rough Chaff, ordinary crop ..	60½	56	1119	108	1227	5	13	4	1652	1	9	6	7	2	10
Mr. Malden.															
Dattel	60	42	697	18	715	3	0	0	1570	1	1	3	4	1	3
Seedling White ..	62	44	804	44	848	3	10	3	1561	1	1	0	4	11	3
Browick, ordinary crop	59	51	1182	188	1370	5	7	0	2800	1	17	6	7	4	6
Mr. Edwards.															
Dattel	59	42	912	14	926	3	6	10	1260	1	5	0	4	11	10
Seedling White ..	59	44	1144	24	1168	4	8	11	1484	1	10	0	5	18	11
White Chaff red, ordinary crop ..	58½	40	1041	37	1078	3	17	7	1470	1	10	0	5	7	7

to be desirable for these crops. As, however, the conditions under which the ordinary and competing crops were grown were so different, it is not possible to compare or contrast them with any practical result. In the other localities the various crops were grown under the same conditions, and the results show that no real gain accrued from the cultivation of the competing varieties (Table IV.). The total value of the crops in all the stations of each kind cultivated shows that while the "Dattel" had the value of 20*l.* 14*s.* 3*d.*, and the "Seedling White," 22*l.* 15*s.* 3*d.*, the ordinary crops were worth 25*l.* 2*s.* 8*d.* When the plots cultivated at Woburn are excluded, the result is not very different; for the "Dattel" was valued at 16*l.* 13*s.* 10*d.*, the Seedling White at 18*l.* 4*s.* 5*d.*, and the ordinary crop at 17*l.* 18*s.* 2*d.*

The Judges appointed by the Council, after a careful examination of the results of the year's cultivation, and a comparison with the portions retained of the original samples, came to the unanimous finding, which is incorporated in their Report as follows:—

Report of Judges.

The sample No. 1 is a pure wheat. It is entered as a variety produced by a cross between "Red-eared Chiddam" and "Prince Albert," but, in the opinion of the Judges, no characters exist in the sample sent, or in the produce of this year's growth, to justify its being considered a new variety.

The sample No. 2 contained a large proportion of red grains, and the specimen sheaf was also a mixture of white chaff and white grain, and white chaff and red grain with a few red chaff and red grain. The produce of this year's growth having the same mixed character, the Judges do not consider this a distinct variety of wheat, and therefore disqualify it.

The Judges desire to add that they had submitted to them samples of the ordinary crops of the farm, grown under the same treatment alongside of the competing samples; some of these were red wheats, but one was a sample of white wheat, which compared most favourably as to quality with both of the competing varieties, but greatly exceeded them in the money value per acre.

(Signed) CHARLES HOWARD,
JONAH HADLEY,
HUGH RAYNBIRD.

The two attempts made by the Society to encourage the production of improved varieties of wheat have not resulted in any real gain. The competing varieties which were cultivated in 1880, like those just reported on, did not prove superior to the wheats which, in the different districts where the trials were made, had been selected for cultivation. The experience of the past in regard to the production of valuable varieties of wheat, leads one to expect that new sorts may still be obtained by careful selection or by crossing. It is to be

hoped that though the prizes offered by the Society have not as yet yielded any important present results, they have at least directed special attention to the subject, and set agoing experiments which may in the future be productive of substantial gain.

VIII.—*Notes on Cart Horses.* By JAMES HOWARD, M.P., of Clapham Park, Bedfordshire.

DURING the period which has elapsed since the establishment of the Royal Agriculural Society, more than one important change has come over peoples' opinions with regard to the best style of draught-horse for farmers to breed. In the greater portion of England most celebrated for the breeding of cart-horses, the old-fashioned dray-horse had held undisputed sway, until the Shows of the Royal Agricultural Society brought into prominence horses of lighter build and quicker step; the handsome clean-legged Suffolk and the active Cleveland bay attracted no little attention. Whether or not these exhibitions had the effect of influencing fashion in breeding, it is certainly the fact that after their establishment a change took place in public opinion in favour of clean-legged, active horses for farm purposes; and the more massive, slower moving, and hairy-legged breed fell correspondingly in general estimation. For many years it became quite the fashion for noblemen and other landed proprietors to introduce a Suffolk stallion into their district, with a view to improve the local breed and obtain a race of clean-legged horses. The object was, doubtless, secured in many districts, but it was quickly discovered that the attainment of the qualities desired was attended with loss of bone; for the Suffolk horse, notwithstanding his fine big body, was, as he has remained, light of bone, especially below the knee. During the time of which I speak, the Royal Agricultural Society dropped its prizes for "Dray-Horses," a step denoting the change which had come over public opinion.

The infallible effect, however, of the law of supply and demand stepped in before a very long interval had passed, and turned the tide in the opposite direction. The construction of railways and other public works led to a large demand for powerful, massive horses; the supply proving unequal to the requirements, caused this description of draught-horse to rise inordinately in value. The demand was for horses of greater, and still greater substance; whilst coincident with the demand for greater substance came the insistence that such horses should be able "to move as well as draw."

The Clydesdale and Shire Breeds.

I have no desire to enter into controversial questions respecting the origin or the merits of the Shire and the Clyde breeds, but simply to refer to facts which have become historical. The Scottish farmers were not slow to perceive the necessity for increasing the size and power of their esteemed Clydesdales to meet the demand for stouter horses, and English breeders have learned by revelations which have recently reached them from Scotland, how for a long period many of the best of their Shire-bred mares were quietly carried over the Border for the purpose of improving the Clydesdale breed. Not a few of the most celebrated pedigree Clyde stallions, it is found, are descended from English Shire mares; indeed, it is now no longer a secret that even the renowned Clydesdale horse "Prince of Wales" (673) has Shire blood in his veins, derived through his ancestor "General," whose dam was a Shire mare which won a first-prize in the brood class of the Highland and Agricultural Society's Show at Glasgow—the very centre of the Clydesdale-breeding-district. Again, "St. Lawrence," the Champion at Glasgow two years in succession, and first prize at the Royal Agricultural Show, York, has Shire blood in his veins from both sides. Mr. Lawrence Drew, of Merryton,* one of the foremost of Scottish breeders, with a view to increased weight, bigger bones, and hardier constitution, has for some years past openly advocated the crossing of the Shire mare with the Clydesdale stallion, in which practice he has attained the greatest success.

I have a distinct remembrance of what the Clydesdale horse was some thirty-five to forty years ago; and those interested in the subject, who cannot go back in memory so far, have only to glance at the illustrations of famous Clydesdales which appear in Stephens' 'Book of the Farm,' to see what the breed was like at that period.

Having said thus much upon the Clydesdales being improved by crossing with the Shire breed, it is but fair to acknowledge that the greater activity of the present race of Shire horses may possibly have been derived from the large number of quicker-stepping stallions which have been brought from beyond the Tweed; and may not be altogether due to more careful selection of the original breed. For myself, I may say that the introduction of a Clydesdale stallion, which I purchased from the late Mr. George Hope, Fenton Barns, upwards of twenty years ago, was

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* This renowned breeder has passed away since this paper was sent to the printer.—J. H.

attended with considerable benefit. This sire, a big-boned, active, and powerful horse, left his mark in my neighbourhood, as did another but lighter Clydesdale I well remember, which travelled in this county some forty years ago.

Hair and Bone.

Formerly the opinion was entertained that sluggishness and inactivity are inseparably combined with massiveness of bone and carcass; and further, that an abundance of coarse hair is necessary to big bones and massive frames. The modern breeders of Shire horses have aimed, not only at better action, but at maintaining the size of bone and body, and at the same time obtaining a more silky description of hair. A grave doubt, however, arises whether the profusion of hair and "feather" insisted upon in Showyards and among the leading breeders of Shire horses are really so essential to strength and constitution as is generally asserted and believed. As a farmer of heavy clay-land—much of it hilly—which requires very powerful horses in tillage and in carting, I have long entertained doubt as to the policy of the present tendency to such a profusion of hair. Breeders not only contend for hair on the rear of the leg, but many have also come to insist upon a mass of hair in front, from the knee downward—doubtless a characteristic of many of the old Shire horses bred in Derbyshire early in the present century. Of course no one contends that all this hairy covering is desirable in itself; it is advocated as being essential to hardiness of constitution and size of bone. This contention merely means that the desired constitution and sufficient bone have not hitherto been obtained without an abundance of hair.

It is with some diffidence that I have ventured to take a view differing from that held by so many eminent breeders; but I am emboldened to do so by the knowledge that a large number of very practical, shrewd men whom I have consulted upon the point entertain a similar opinion, indeed hold it very strongly. I must say that the modern predilection and arguments in favour of profuse hair are not justified by my own experience, for some of the most powerful and biggest-boned horses—with the hardiest constitutions—I have had during the past thirty years have been free from an excessive quantity of hair.

Shunting railway trucks probably tests the strength and joints of horses as severely as any work to which they can be put. Before this operation was performed at the Works of my Firm by a locomotive, horses were employed; the strongest and most lasting horse we ever possessed for this purpose was a deep-bodied, flat-sided, slow-moving gelding with quite clean

legs; he was bred by my brother, Mr. Charles Howard. Although a breeder of pedigree Shire horses, I desire to recognize merit in other breeds, and therefore acknowledge that the horse in question was a half-bred Suffolk, his sire being a famous Suffolk horse, "Manchester Boxer" (298), belonging to the late Duke of Manchester; his dam, a very big, wide mare. "Duke," after having been superseded by the locomotive, lived to do many years of hard work upon the farm, occasionally returning to his former labours when the engine was out of repair.

Nor does the popular contention for a profusion of hair accord with my observation beyond my own farms and factory. When on a visit to my friend, Mr. Jessop, of Sheffield, some three years ago, I was shown the best and strongest draught-horse employed at the great steel works of his firm. He was bred in Yorkshire, and is a wide, massive gelding, possessing great bone, and capable of moving immense loads, yet almost as clean as a Suffolk; he is evidently, and as I was assured, of wonderful constitution. At the present time I have upon my farms a very massive and deep three-year-old filly, $11\frac{1}{4}$ inches below the knee, but with only the slightest covering of fine, silky hair. The filly is by "Hydraulic" (1130). I bought her, when a yearling, at the great sale of Mr. Waltham, of Parson's Drove, for 145 guineas; she was pronounced short of hair, or would doubtless have made a still higher price.

Mr. Oakley, the General Manager of the Great Northern Railway Company, London, whose opinion I asked, wrote as follows: "For railway work, horses with long hair on their legs are very unsuitable, and we avoid purchasing them as much as possible. We find the long hair very difficult to cleanse effectually; and if carelessly done, the hair 'mats' at the root and, in the opinion of our 'master of the horse,' provokes grease and other inconveniences. We have in London about 1100 horses, the bulk of which are kept at, or adjoining to, King's Cross. We shall be happy to show you the stud when it may be convenient for you to come." An invitation which I quickly availed myself of.

Mr. Newcombe, Goods Manager of the Midland Railway Company, wrote as follows: "In reply to your enquiry as to what is our experience of the hairy-legged class of horse, I can only say that we purchase as few of them as possible, and always prefer a clean-legged animal. We have a decided objection to the coarse, hairy-legged horse, and I entirely concur with our chief veterinary, Mr. Taylor, when he says that such horses are more predisposed to disease, such as itching of the legs, grease, &c. I send for your perusal a copy of the report he has made to me upon this subject."

The report is as follows:

"Respecting cart-horses, as to their having much hair on their legs or not, I am of opinion that the most serviceable and best class of horse is the one that has plenty of good, flat bone, and a fair amount of soft, silky hair. I find that horses that grow a quantity of rough, coarse hair—especially in abundance round the fetlock joint and in many cases hanging over the hoof—are more predisposed to disease, such as itching of the legs, rough legs, grease, &c. No doubt this arises in some measure from the inability to thoroughly cleanse the legs from dirt, &c., and also I consider these horses are more constitutionally predisposed to these diseases."

With a view to stimulate the growth of hair, it is not an uncommon practice with Shire-horse breeders to use a little common blister-ointment, with a plentiful supply of sheep-ointment, well rubbed in on the back of the legs; the same treatment is adopted for preventing the hair from shedding in the summer.

I would submit to the consideration of breeders that, looking to the fact of fashion having changed more than once during the past forty years, and in view of the possibility of another turn in popular taste, whether it may not be advisable to aim at producing the most powerful horse, as free as possible from the objection so forcibly pointed out by the two Railway Managers, instead of running in the opposite direction and endeavouring to load the legs of the horses of the future with a still greater profusion of hair.

Size.

A few words with respect to Size. Farmers in hill countries, and many users of draught-horses in towns and cities, require for their purposes a compact horse, not exceeding sixteen hands. Probably a time will arrive when this class of horse will be established as a separate breed, in the same way as the white pigs have been divided into large breed and small breed. At all events, this is a kind of horse worthy the encouragement of Agricultural Societies; for, independently of the home customer, a great demand exists which English breeders fail to meet. Immense numbers of the French *Percheron* breed are bought by foreigners, because our English horses are too ponderous for their requirements. I am quite aware that if an English Shire-horse breeder be spoken to on the subject, his reply will be, "my difficulty is to breed horses of sufficient size. I can always sell big ones." But horses of sixteen hands, if wide, powerful, and with good action, are also quite as saleable. I will not say they are more useful or fetch quite as much

money, but they are wanted in greater numbers than the more ponderous horse of seventeen hands and upwards, and cost somewhat less to produce. I was fortunate enough to take the first prize at the Royal Agricultural Meeting at Bedford for a magnificent pair of Shire bays, which stood 17·3; neither was better at a big load, if as good, than other horses in my possession standing a hand-and-a-half lower. At the present time I have two remarkably powerful Shire-bred mares which stand rather under than over sixteen hands.

By the foregoing remarks it must not be inferred that I wish to discourage the breeding of horses of great size; on the contrary, I aim at producing such animals myself. My object is rather to suggest a classification of the breed, for assuredly both a home and a foreign demand exist for each description.

Conformation.

In the selection of horses for breeding purposes, it has often occurred to me that sufficient importance is not usually assigned to the osseous structure of the animals; nor is this a point which has been prominently dealt with in the numerous essays upon the subject of horse-breeding, which have appeared in the Royal Agricultural Society's 'Journal' and elsewhere. Yet the external form and the great point, now-a-days, of action are almost entirely dependent upon the proportions and position of parts of the framework of the animal.

The first point to which I would direct attention has reference to action. Most writers on the horse attach great importance to a sloping shoulder-blade or *scapula*, without paying adequate attention to the position of the bone jointed to it, the *humerus.*

In the accompanying drawing (Fig. 1) the *humerus* (*b*) is shown in the best position; and in Fig. 2 it is displayed in a worse position. It will be observed that, in Fig. 1, the centre line of the shoulder-blade (*a*) and the *humerus* form together an obtuse angle; the *humerus* bone being at the same time in a position more approaching the perpendicular, relatively to the ground, than in Fig. 2. It follows from this position that the fore leg is put into the shoulder well forward; and consequently that there is less "loading" at the shoulder-points, and therefore less to impede action. In the purchase of draught-horses, as well as riding-horses, I have, for many years, paid greater attention to the angle of the *humerus* than to that of the shoulder-blade; for I have been convinced by experience that the fore action of a horse, apart from the question of muscles, is governed almost entirely by the position of this

bone. I say, apart from the question of muscles, for undoubtedly these exercise no little influence upon action, although the exact manner is beyond my knowledge. Two of the best weight-carrying hunters I have ever ridden had, what

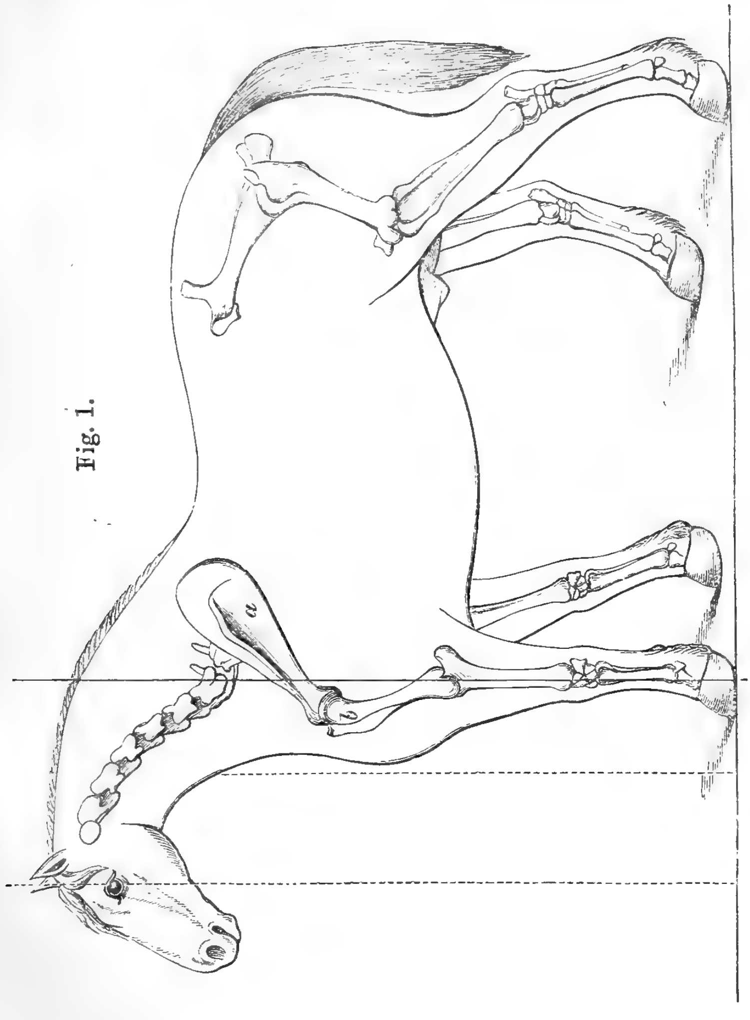


Fig. 1.

were deemed, upright shoulders; but this was compensated for by their fore legs being put in very forward, arising from the angle of the *humerus* bone approaching that in Fig. 1. I have never possessed a horse with first-rate walking or trotting action with shoulders resembling Fig. 2, p. 316.

In Fig. 2 is an example of a horse having a shoulder-blade in the same angular position with relation to the ground as in Fig. 1, but with the *humerus* placed so sloping backward as to form with the centre line of the shoulder-blade almost a right angle, instead of an obtuse one as in the former case. It will

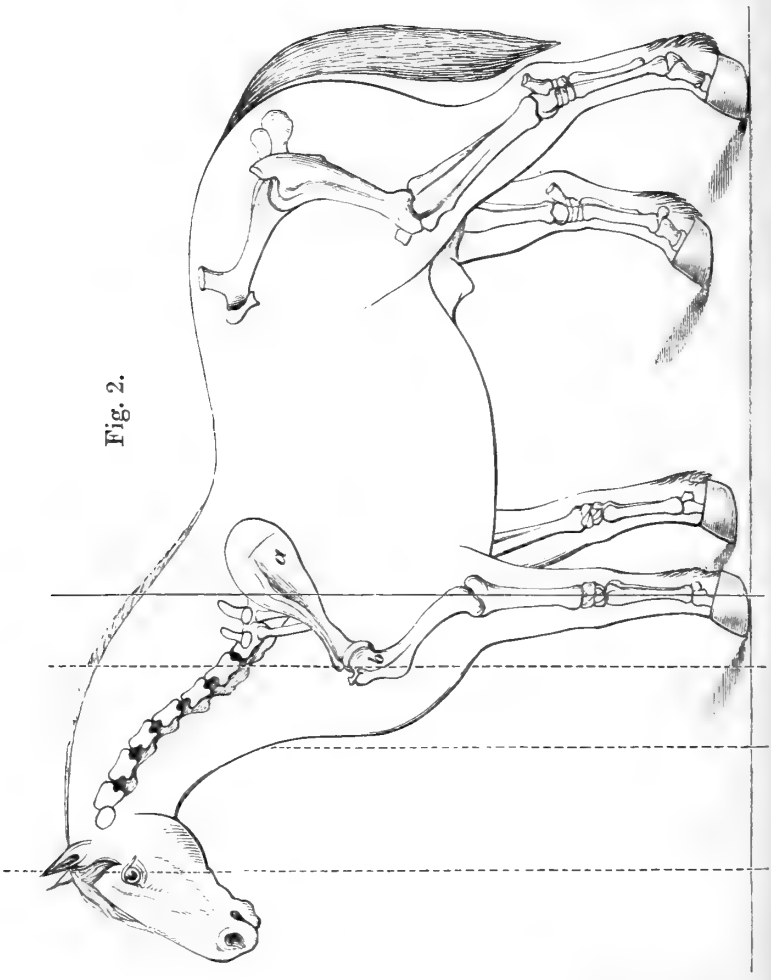


Fig. 2.

be seen from Fig. 2, that the fore-leg is of necessity thrown further back under the horse, and there is consequently a larger amount of "loading" at the shoulder-points.

No man possessing knowledge or experience would choose a riding-horse with upright shoulders, unless there were present

some redeeming feature; but in the case of a draught-horse there is not the same force in the objection to upright shoulders. Indeed, I am not prepared to dispute the arguments of some writers that there is some advantage arising therefrom in the collar strain being distributed over the horses' framework more evenly than is the case with very slanting shoulders. However, I have had cart-horses possessing what nag-breeders would call splendid shoulders, which were remarkable for their power of drawing heavy loads; but these sloping shoulders were united with withers high and muscular, and presenting a good recess in front of the *scapula* for the collar. It should be borne in mind that the notion of a well-sloped shoulder-blade being essential to, and always connected with, a well-placed *humerus*, is entirely erroneous; for in many horses with good, slanting shoulders the *humerus* is found in quite as bad a form is in the example Fig. 2, and such horses are very apt to stumble.

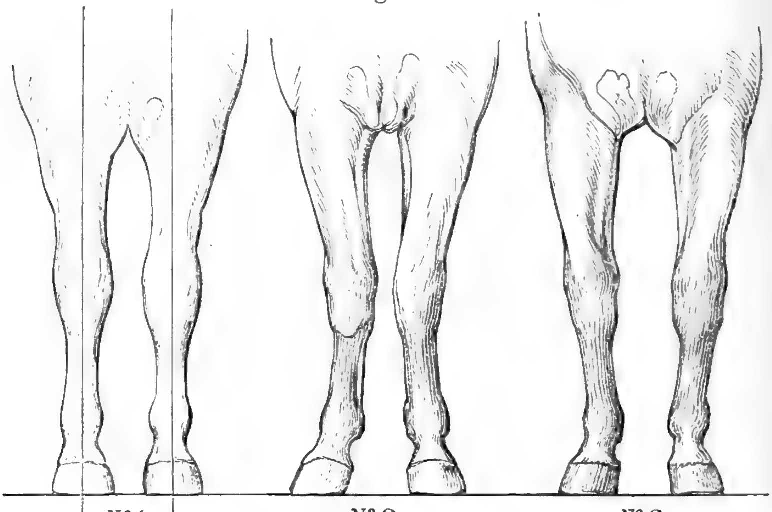
In order that the action may be perfect, it is not only necessary that the joints referred to should be properly formed, but also that both fore and hind legs should be correctly shaped and placed. On p. 318 are given three illustrations of fore legs; and following are three specimens of hind legs, in end view. The right position, it will be obvious, is indicated by No. 1; the central lines showing that the weight of the animal rests upon supports well-nigh perpendicular in structure and position, whilst the other examples may be compared to resting a building upon iron columns cast out of the straight, or erected out of the perpendicular. The comparison is even worse than this; inasmuch as in a building there is only stability to be considered, and no locomotive wear and tear to be contended with; whereas, in a case of the horse, such natural defects in the direction of weakness have to sustain the shocks of constant concussion and wear.

The same reasoning does not apply with equal force to the hind legs, which have not to bear so large a proportion of the weight of the carcass or to withstand the same force of concussion. The office of the hind legs is rather to sustain the strain arising from propulsion. The position of the several joints, as indicated by the centre lines in No. 1, will show, without argument, how much better they are placed for withstanding the strain thrown upon them than are the corresponding parts in the other drawings.

I deem it unnecessary to dwell upon points with which every breeder has long been familiar—such as flat legs, large joints, clean hocks, and big thighs. But I will turn to that most important point, the foot. In passing, however, to that, I must call attention to the necessity of the coronet and pastern-bones

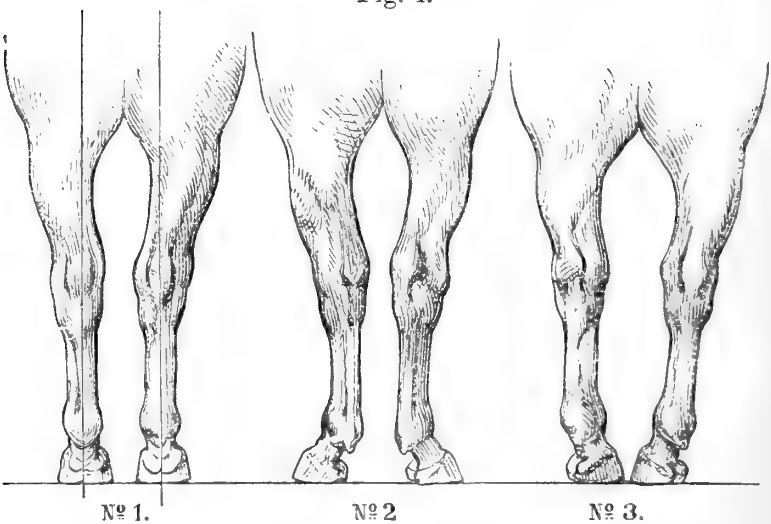
being of sufficient diameter; for, if deficient here, no matter how large the bone may be below the knee, these parts will form a source of inherent weakness.

Fig. 3.



№ 1. № 2. № 3.

Fig. 4.



№ 1. № 2 № 3.

In the purchase of cart-horses, and particularly in selecting for breeding purposes, it is obvious that the very first point for examination should be the foundation upon which the whole

structure rests. A cart-horse should not only have big and broad feet, but ample depth at the heels is also essential. For unless there is depth of foot there will be diminished flexibility; and consequently, the animal, though able to endure farm-work, will not be so capable of standing the severer test of the road or City traffic.

Although having more hair than I desire, but as an example of perfect symmetry combined with great power and grand action, I have selected for illustration "Spark" (2497), the magnificent stallion belonging to Mr. Walter Gilbey, of Elsenham Hall, Essex, the President of the English Shire-Horse Society. "Spark" gained First Prize as a three-year-old at the Royal Agricultural Show, Derby, 1881, and has twice been Champion Stallion at the Agricultural Hall, London.

This splendid specimen of the Old English Shire horse, illustrated on the next page (Fig. 5), was bred in the Vale of Aylesbury by Mr. W. R. Rowland, of Creslow, who sold him in 1881 to Mr. Walter Gilbey for 800 guineas. "Spark," in Show condition, weighs $22\frac{1}{2}$ cwt., stands 17·1, and measures as follows:—

Girth behind the shoulder	98	inches
Extreme girth around belly	102	"
Girth of fore-arm	$30\frac{1}{2}$	"
Girth of fore leg below knee	$12\frac{1}{2}$	"
Girth of hind leg below hock	15	"
Girth of second thigh	$24\frac{1}{4}$	"
Height to top of quarter	$68\frac{1}{2}$	"

Physiology of Breeding.

Having expressed my views upon the structure of the cart-horse, I will venture a few words with regard to the Physiology of Breeding. In a Paper which I contributed to the 'Journal' in 1881, upon "Pigs, their Breeding and Management," I treated this topic; and as the remarks then written apply with equal, if not greater force to the breeding of horses, I reproduce a portion of them here.

"Some thirty years ago I was led to study the physiology of breeding through meeting with a remarkable book, 'Intermarriage,' by Alexander Walker, which, although devoted to the human family, contained valuable treatises upon 'The Application of the Natural Laws to the Breeding of Horses, Cattle, and Sheep.' In 1854 Mr. Reginald Orton, a medical practitioner of Sunderland, delivered two lectures to the Newcastle Farmers' Club upon 'The Physiology of Breeding,' in which (following Mr. Walker's views) he laid down certain fixed principles. Subsequent observations and experience have

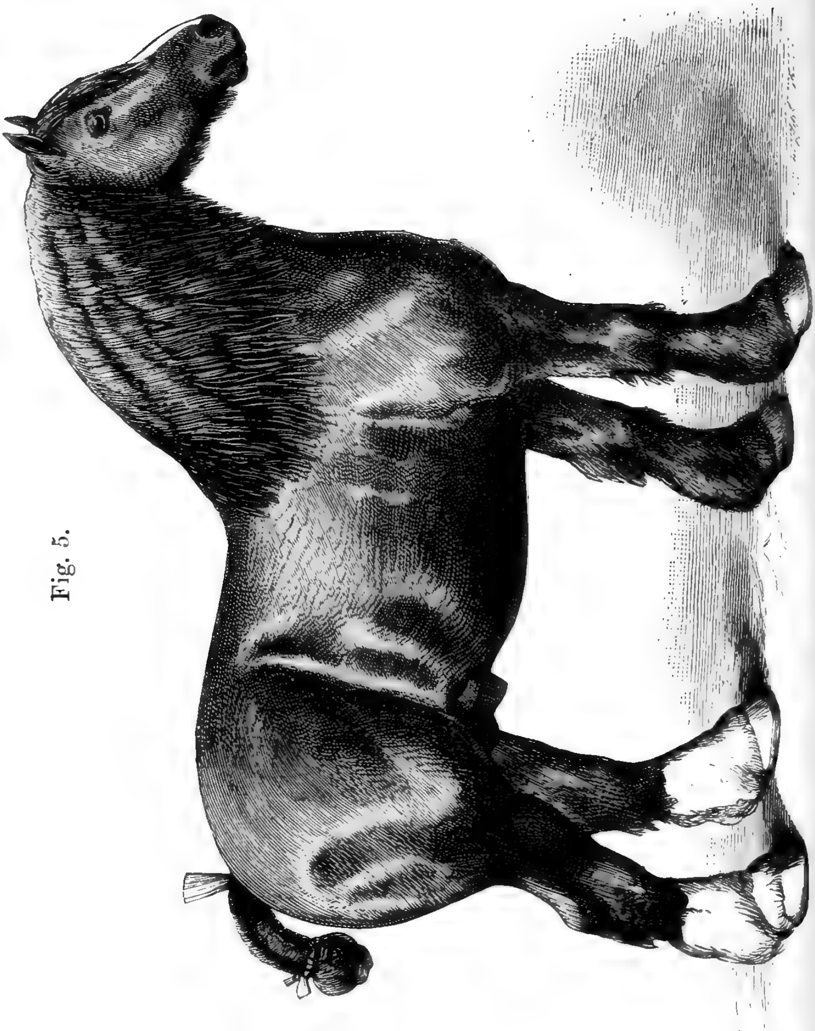


Fig. 5.

satisfied me that the principles thus laid down are sound; and although, like every other breeder, I know something of the uncertainties attending the breeding of animals, yet I am convinced that there are certain laws pertaining to the process, which, like all Nature's operations, are fixed and unalterable, and which cannot be disregarded with impunity.

"From my own observation, from conversations with the late Mr. M'Combie, M.P., and comparing notes with other breeders, I have come to the conclusion that the following cardinal points in the art of breeding have been fairly established:—

"That from the male parent is mainly derived the external structure, configuration, and outward characteristics—the locomotive peculiarities inclusive.

"From the female parent are derived the internal structure, the vital organs, and, in a much greater proportion than from the male, the constitution, temper, and habits.

"That the purer the race of the parent the more certainty there is of its transmitting its qualities to the offspring. Say two animals are mated; if one is of purer descent than the other, he or she will exercise the more influence in stamping the character of the progeny, particularly if the greater purity is on the side of the male.

"That, *apart from certain disturbing influences or causes*, the male, if of pure race, and descended from a stock of uniform colour, stamps the colour of the offspring.

"That the influence of the first male is not unfrequently protracted beyond the birth of the offspring of which he is the parent, and his mark is left upon subsequent progeny.

"That the transmission of diseases of the vital organs is more certain if on the side of the female: and diseases of the joints if on the side of the male parent."

In the Paper in which the above extracts appear, I adduced numerous facts in support of my conclusions. These it is unnecessary to quote, as the readers of the 'Journal' may find them in Vol. xvii. S.S., Part I.

I would add, that I have since had opportunities for further observation. For instance, in 1879 I purchased at the first Shire-horse sale of the Earl of Ellesmere the celebrated horse "Columbus" (503, Stud-book). He was a horse of remarkable beauty of form, grand action, and well descended. Nearly all his progeny, even from plain mares, bear a more or less close resemblance to him, and also inherit his grand action. He was the sire of "Paragon" (1707), a horse I had never seen until exhibited at the 1883 Show in the Agricultural Hall, Islington.

I at once recognized him, and my horse-man, who also had never seen him, picked him out the moment he came into the ring, remarking, "*The picter of the hold 'oss!*"

Some Points in Management.

And here I would observe that no portion of horse management appears to be more neglected in this country than attention to the condition of the feet. And this, not only upon farms, but, as I have witnessed, in establishments where hundreds of horses are kept. When at the Paris Exhibition in 1867, my attention was forcibly directed to this point. I had obtained the first prize for the best pair of cart-horses; the Judges pointed out to me the difference between the condition of their feet and the condition of the feet of horses shown by the French exhibitors, and they alluded to the general neglect in this matter, which they alleged to prevail in England. I was subsequently invited to the stables of the Paris General Omnibus Company, where I found the utmost attention paid to the feet of the animals—the feet being soaked twice a week in a preparation of fat, beeswax, and tar. The following is the receipt: 1 lb. mutton fat, 1 lb. beeswax, 5 pints neatsfoot-oil, 6 tablespoons Stockholm tar; the whole simmered together. In the case of farm-horses the application is not needful, except when the animal has dry, harsh feet. But for both nag and cart-horses used upon the road, I have found this dressing, as well as mutton-fat alone, to be highly beneficial.

Like most other owners of horses, I have had much to contend with from the inveterate habits of shoeing-smiths in paring and rasping the hoofs. The sole, frog, and bars should not be tampered with, but maintained at their natural growth and strength. If the sole be cut away, how is it to be expected that the foot will support the weight of the body when brought into contact with hard and sharp substances? Or how can the heels remain expanded, and the foot of its proper shape, if mutilated by the drawing-knife? In preparing the foot for the shoe, it is only necessary to lower the wall to a level with the sole; the other parts require no touching by either rasp or knife. This habit of paring and rasping is so inveterate in shoeing-smiths, that I have found nothing but the most peremptory orders effectual to stop the practice.

The advocates of the abandonment of shoeing have of late increased; and although the banishment of horse-shoes appears to be as remote as when Xenophon wrote in condemnation of these artificial protectors of the feet, I am bound to confess that in some cases I have witnessed the best results from working

horses unshod upon the roads in this country, and also upon many farms in foreign lands. Should any injurious consequences arise from using horses without shoes, there would be a *per contra* side of the account in the avoidance of many injuries now resulting from neglect and carelessness on the part of shoeing-smiths.

In a recent report of the Paris Omnibus Company it is stated "that the best results have been obtained from putting as little iron under the feet as possible, and keeping the middle of the foot intact." As steel has become so cheap, and has been substituted for iron for so many purposes, a question arises whether lighter shoes of mild steel would not prove more economical than heavier shoes of iron.

With respect to stables: except during the warm months of summer, my farm-teams are lodged in the stables throughout the year. They are removed from the pastures towards the end of August or early in September; after which time, except the nights are unusually hot for the season, exposure is sure to reduce their condition,—a very dangerous thing at the near approach of winter. If the stables are sufficiently large and well ventilated, I see no advantage in the common practice of turning teams into open yards for the night. Advocates of the system maintain that horses thus treated are less liable to cold and influenza, but, from my experience, I think this is a matter entirely of ventilation and size of the stables. For if a sufficient amount of fresh air be admitted, the temperature of the building will not be raised to a point liable to endanger the health of the animals, or to make them tender. Turning a horse into a yard, even when provided with good shelter-sheds, cannot but be attended with considerable loss of animal heat.

Stables, however, cannot be healthy unless the flooring is impervious, and the soil, if clay, well drained. The exhalations from a porous flooring are most injurious; and the damp sucked up and evaporated by the walls, if built of porous material, is calculated to produce influenza.

Many years ago, when at the stables of a celebrated dealer in hunters, at Hendon, Middlesex, the proprietor said to me:—"I wish you could tell me, Mr. Howard, how to keep my stables dry: I am much troubled with influenza, and have just lost another valuable hunter." The stables being upon "London Clay," I advised him to lay a drain around the outside of the stables at a depth of 6 inches below the foundations, and a corresponding drain right through the centre of the block of buildings. The advice was given with a view to prevent capillary attraction by the walls, and to cut off the subsoil water. This well-known dealer adopted the suggestion,

and, several years afterwards, told me that the plan had proved most effectual, and that he had enjoyed an immunity from his former troubles.

In conclusion, I would observe that if the breeding of cart-horses has been neglected, or has not been carried on as extensively as it might have been in the past, the pursuit is not likely to suffer from unconcern in the future. The greater interest manifested at the present time, as indicated by the rapid growth of, and wide-spread interest felt in, the English Shire-Horse Society, and in the sister-society across the Border—the Clydesdale—are unmistakable signs of the times. The large number of valuable cart-horses exhibited at the Shows of the Royal Agricultural and other Societies, the magnificent displays at the Agricultural Hall and at Glasgow in the spring, are evidence that the breeding of high-class cart-horses has been taken up with greater spirit than at any former period. The large demand for first-class stallions for the United States, our Australasian Colonies, and other countries, is imparting a considerable stimulus to the present race of breeders; and as pedigree is held in high estimation, indeed is insisted upon by both Australian and American buyers, the Stud Book of the English Shire-Horse Society was not started a moment too soon.

IX. *Reports of the Honorary Consulting Entomologist.* By Eleanor A. Ormerod, F.R. Met. Soc., Dunster Lodge, Isleworth, near London.

November 1883.

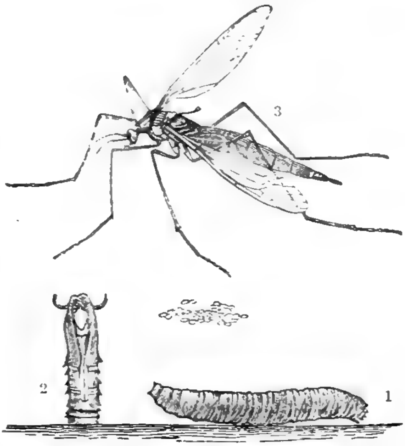
I beg to report that during the last year I have received a very large number of inquiries regarding insect attacks and methods of prevention, showing that insect attacks have been very prevalent, especially those of the maggots of various kinds of flies, as daddy longlegs, beet- and mangold-fly, cabbage-root fly, and parsnip and celery-leaf maggots.

The daddy longlegs have been reported from Caithness down to Brighton, and as injurious to many of the common crops, but especially to corn after clover.

Thorough cultivation, which clears the ground of the clods of roots under which the grubs may be found swarming in such localities, and which gives a healthy growth past attack, has been found serviceable. Also when the grubs have been present, a fertiliser, such as a dressing of artificial manure, or a mixture of guano and salt, or guano and salt with kainite and superphosphate, has proved perfectly successful in checking attack, and returning a crop without further loss than the outlay on the manure.

The very large numbers of the daddy longlegs which have been about during the autumn make it probable that great mischief will be done by the leather-jackets next spring, and it would be very desirable to point out that all the measures

Fig. 1.—*The Daddy Longlegs.*



1, Larva; 2, Pupa-case standing up in the ground; 3, Fly.

which have been found practically useful to clear wireworm—in breaking up pastures and clover ley—would be as useful in getting rid of the daddy longlegs grub (that is, the "leather jacket," or "black grub"). These consist of heavy dressings of lime, gas-lime, lime and salt, or alkali waste, to kill the surface insects and sheltering weeds, or in gaining the same object by feeding cattle or sheep on the ground.

Beet- and mangold-fly attack has been bad, and the only remedy when it is present appears to be the application of dressings which will act at once to stimulate growth; but when attacks occur in drought, there is the difficulty of these not acting. I would submit that in the case of this attack, as with turnip-fly, autumn preparation, or such preparation of the land as would preserve the moisture of the soil, as well as give a rich ground and good tilth, is an important preventive, so as to run the plant rapidly on to a size of leaf, which the maggot has less effect on.

Fig. 2.—*The Beet-fly.*

1, Pupa, natural size and magnified; 2, Fly; 3, Head of fly, magnified.

I have notes from various quarters of the presence of crop grubs and maggots in farmyard-manure, especially of daddy longlegs grubs, and wireworm, also of cabbage-maggot, and in the case of the daddy longlegs grubs, of their being thus carted to the ground and spread along the ridges; and I have no doubt that fields are often thus infested from the manure, as some of our crop-maggots infest vegetable matter, whether fresh, or putrid, or in the mixed condition of farmyard-manure.

In the case of cabbage- and turnip-maggot, which has been very destructive in England, and in some parts of Scotland, the returns show the attacks to have been worst on heavily manured land; absent, or nearly so, where the ground has been well treated with gas-lime previously; and that, when attack was present, the crop was sometimes saved by the application of artificial manure, such as a mixture of guano, superphosphate, and salt; or the attack checked by rain washing down a dressing, such as mineral superphosphate or nitrate of soda already on the land.

In the case of mangold-fly above mentioned I have no notes of the use of salt; but, looking at the great effect that this has been found to exercise on the growth of mangolds, it may be suggested that it would be likely to prove very beneficial, either mixed with the farmyard-manure, or as a part of a mixed dressing during attack.

Amongst the attacks of the autumn on turnips there has been considerable damage from the small green caterpillars of the diamond-back moth. This is believed to be of rare occurrence, but when it does happen it is often so exceedingly injurious that there is reason to think it has been confused with that of the turnip-saw-fly caterpillars, or "niggers." These two kinds of caterpillars may be distinguished by the diamond-backs being green all their lives, whilst the so-called "niggers" are only greenish at first. Also, they often spin a deal of *fine web on the leaves* they are destroying. The diamond-back moths are about the size of a clothes-moth, with markings forming diamond-shapes along the edge of the wings when folded.

This attack has been chiefly noticed on or near the eastern seaboard near Harwich and Lynn, and in Yorkshire and Caithness. It has been found that the same kind of treatment applicable to "niggers" is serviceable against attacks of the diamond-black moth caterpillars. This is dressing with fertilisers (as nitrate of soda), brushing with boughs to knock off the grubs, and (generally) keeping up a healthy rapid growth.

Many replies have been sent in regarding the first appearance of aphis on hops, of which the main points are that attack is

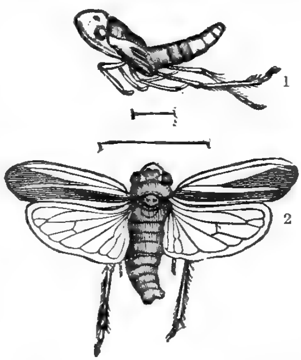
generally believed to appear first in the form of fly (that is, of the winged aphis) on the uppermost shoots and leaves; but there are also a few notes of the so-called "lice" being first seen, also of their being observed in the ground, and creeping up the stems.

In a case of isolation of a hop-plant, which was carefully enclosed from outer attack, it remained quite clean for about three weeks or more, and afterwards was so badly infested that it was almost killed. I have been confirmed by Mr. Buckton in the certainty of one kind of aphis, which infests the plum, being the same as the hop aphis; and I have also received specimens of the common nettle with aphis multiplying on the leaves, which differed in no way that I could see from the hop aphis.

The subject of dealing with hop aphis attack is one which can only be judged rightly of by those practically acquainted with the matter, and I am therefore arranging the notes for distribution amongst the contributors, who may then help to give further information.

In the course of inquiry, notes have been given of the hop frog-fly, jumper or cuckoo-fly (*Euacanthus*), of which two kinds at least infest the hop, and of which the starting-point was wanted. It has been found in its earliest stage coming up from the earth round the hop; therefore, any application which would keep the cuckoo-flies from going down or laying their eggs on the surface in autumn, or any treatment which would clear eggs or larvæ from round the stems, or would prevent them getting up the stems in early summer, would be very serviceable.

Fig. 3.—*The Hop Frog-fly.*



1, Larva; 2, Fly; both magnified. The lines indicate the natural size.

Notes on many other attacks have been sent in from practical agriculturists; and among those to fruit and bush fruit it may be remarked that a large proportion would be much lessened by paring off about two inches of the soil under the attacked trees during winter, and so disposing of it that the chrysalids or cocoons within it should be destroyed.

Inquiries have also been sent regarding other crop pests, as false wireworms or millepedes, and field slugs, to all of which I have attended carefully, and have satisfaction in mentioning that sometimes, and especially with regard to slugs, I have

been favoured with information that the treatment was successful.

The numerous inquiries which have been sent in during the year show that the interest taken in the subject of prevention of crop attack has much increased amongst members of the Society, and generally amongst agriculturists and growers at home and in the colonies.

FEBRUARY, 1884.

I beg to submit that since my Report of November, 1883, I have received communications on the following subjects:—

Specimens of seed-heads of *Alopecurus pratensis*, "Meadow Foxtail" grass, have been forwarded, with inquiries whether a small orange-coloured legless maggot by which they were much infested was that of the *Cecidomyia tritici*, or common wheat-midge—often known as "red maggot."

After careful examination, the maggot proved to be that of a *Cecidomyia*, though certainly not of *C. tritici*. It is clearly distinguishable by having a minute forked process, furnished with blunt points (but *not* crescent-shaped), beneath the body near the head.

The agricultural seedsman by whom the specimens were forwarded stated that the imported heads of *A. pratensis*, harvested in 1882, contained about 25 per cent. infested by maggots; those of 1883, about 5 per cent. This refers to seed harvested in Germany and Russia.

More recently a bunch of seeds collected in the neighbourhood of Chester was examined, and found to be much infested.

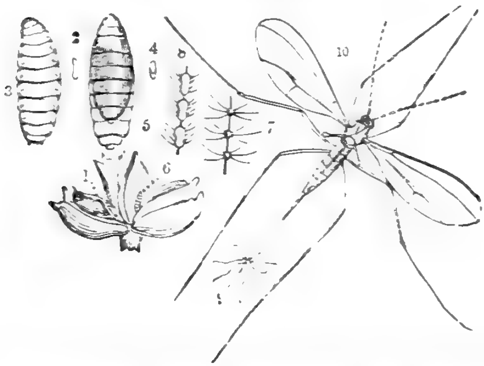
The subject of the presence of these "red maggots" in the "meadow foxtail" heads will receive full attention, as, besides the loss on seed of this grass, it is very likely indeed that, though not the common "red maggot," it may be also present in wheat. I shall, therefore, endeavour to rear the larva, or procure it to be reared, through all its stages, and report further as to the species of *Cecidomyia*, or "gnat-midge," to which it turns.

The only method which is mentioned as being practised at present to prevent attack on the foxtail-grass, is that of gathering the earliest ripened heads for seed. These are free from maggot, because the young embryo of the seed has passed its first soft state (in which only it can serve for food to this kind of maggot) before the grass "gnat-midges" had come out to lay in the blossom-heads.

As these gnat-midges probably go through their changes to the midge-state at the root of the grasses from which the maggot fell down when full fed, and the midges fly up from thence to

infest the next year's heads, it would be desirable to clear wild grasses from the neighbourhood of the seed-land, and to change this as far as could be managed from an infested spot. To destroy the maggot in breaking up ground it would be perfectly effectual to double dig it, or deeply plough it, if it could be left undisturbed, excepting the immediate surface, until August in the following season.

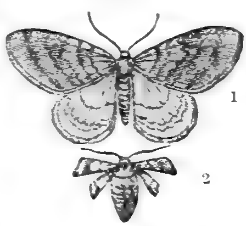
Fig. 4.—*The Wheat-midge.*



1, 2, 4, and 6, Larvæ natural size; 3 and 5, Larvæ magnified; 7 and 8, part of horns of Fly magnified; 9, Fly, natural size; 10, Fly magnified.

From reports sent in each season it appears that great harm is often caused in the fruit-growing districts by the small greenish looper caterpillars of the winter moths, which destroy the leafage of apple and other trees when expanding. As the females of these moths (*Cheimatobia brumata*), and others which come out during the winter, have only abortive wings, and consequently have to walk up the trunks of the trees to reach the branches on which they lay their eggs, it was suggested that measures should be taken to prevent this, and the plan has been tried in an infested locality with perfect success.

Fig. 5.—*The Winter Moth.*



1, Male; 2, Female.

The trees were smeared for a foot or two above the ground with "Davidson's" composition; and by the 11th of November upwards of 500 of the creeping female moths (specimens of which were forwarded) had been caught fast in the sticky material. Each of these moths lays from 100 to 300 eggs, therefore much coming injury was prevented.

Any sticky material which would keep soft for awhile would be equally serviceable, and the plan would answer as well for

other attacks caused by such insect pests as can only crawl up the trees, especially Weevil attacks of some of the commonly very destructive kinds of which the season will soon be coming on. In the fruit-growing counties where these were injurious last year it would be well to be on the alert, and all necessary information will be given on application.

Some of the most important inquiries towards the close of last year have been as to the desirableness of setting up Sparrow Clubs, for the destruction of small birds.

I have pointed out that there are many kinds of these smaller birds which do good by clearing eggs, caterpillars, and insects to an extent which we should miss very seriously if these birds were destroyed; but at the same time I have submitted, as my own personal opinion, that it was likely to cause great harm to raise the numbers *much above the average*, as is managed in some localities by special protection, nesting boxes, and various measures reported relatively to starlings, titmice, and other small wild birds.

In many (or most) cases birds are only partial insect feeders, and, failing these, take what they can get; but in the special instance of the sparrow (*Passer domesticus*), the damage caused by the flocks which sweep down in autumn on the ripe corn is so great near the shelter where these birds congregate, that it far more than counterbalances the benefit of any caterpillar-destroying by them in spring; and from my personal observations of the havoc they cause in wheat, and from the reports of the nature of the food within them, I believe that this special bird is a crop-pest which requires serious attention in the different places where its numbers have *obviously* increased greatly in the last few years.

It is not enough considered in regard to the indiscriminate encouragement of birds that much of our protection from crop insects is from other insects which *feed on them*. An enormous number—several thousands of kinds—live in this way, and are constantly at work in places where no bird could help us. Therefore, where birds make a general clearance, including carnivorous beetles and grubs, parasitic flies, as Ichneumons and others, or (as I have one note of with regard to the starling) even the ladybird, they are not wholly beneficial.

I have, therefore, submitted that, although where great flocks of sea gulls, rooks, titmice, or other birds suddenly appear, following the plough, or on pasture land, or trees, they should *not* be molested, for they would clear off the special insect attack, and leave; yet, for everyday work, the most prudent course is *neither to raise or lower* by artificial measures what is generally pretty well known as the average amount, espe-

cially in the case of the sparrow, which in some districts has increased enormously.

With regard to observations in progress, I find, by the notes of Mr. Lintner, State Entomologist for New York State, U.S.A., that there are more kinds of fly-maggots than the one commonly known here as the mangold and beet-leaf maggot, which also attack the leafage of this crop. It would be very desirable in the coming season for specimens of the maggots to be sent to be reared for identification, as it may help towards finding means to check this kind of attack.

Observations on hop aphis are far from complete at present, but if even half-a-dozen hop-growers could be induced to try enclosing a plant, by merely placing three poles to meet above it, and then covering the plant and poles with an extinguisher-shaped bag made of stout muslin with the edges buried (to prevent any chance of ingress of insects), and would in due time report what was found beneath, we should then have some positive proof as to whether the hop lice come up out of the hill.

I have made arrangements to try this experiment myself, but we need several observations on carefully enclosed plants to be certain of results on a working scale, and it is hoped that hop-growers in the various hop-producing districts will undertake to carry out careful observations in this direction.

In an elaborate work upon the injurious insects to crops in California, by Mr. Matthew Cooke, late chief executive Horticultural Officer of that State, which I have recently received, it is stated that Mr. Cooke has found the hop aphis hibernating in crevices and roughened portions of the poles. He further states that he has found the winter eggs of a species of plant louse in the poles, but he cannot say that they were the eggs of the hop aphis. Mr. Cooke suggests that the hop-poles should be scalded in a solution of potash and water, but this is hardly practicable. I would suggest that investigation of the poles should be made by the hop-planters, and I shall be very pleased to assist them to the best of my ability. I also beg to mention that practical attention to, and the wish to obtain serviceable information on the subject of methods of prevention of, insect ravage, continue (as I mentioned in my previous Report) steadily to increase, both at home and in the Colonies.

X. *Annual Report of the Consulting Botanist for* 1883. By W. CARRUTHERS, F.R.S.

DURING the past year my work for members of the Society has very greatly increased. Five hundred and eight samples of seeds have been submitted to me for examination, and many applications have been made to me in reference to the nature and habits of weeds, and the best means of dealing with them; to the attacks of parasitic fungi on different crops; and to matters affecting the life of plants.

I have, during the year, supplied information to many seedsmen, believing that it was very important to give help wherever a real effort was being made to secure and supply the best and purest seeds. On the other hand I have uniformly declined to supply to seedsmen reports that might be used in the sale of seeds, for this, among other reasons, that it is impossible so to control a vendor as to secure that a report shall be used only for the parcel of seed that had been examined. The unauthorised use, by some seedsmen, in the interests of their trade, of reports which had been obtained from members of the Society, to whom I had supplied them, has been stopped by the Council.

I have examined eighty-five samples of meadow fescue and tall fescue. I include them both under the same head; for, with the exception of three or four cases, all the samples sold as tall fescue were really meadow fescue (*Festuca pratensis*, Linn.). Twenty-six per cent. of the samples were free from weeds and seeds of other grasses; thirty-one per cent. had three-quarters or more of the seed true; twenty-seven per cent. were not so good, but had more than half of the seed true; while sixteen per cent. were still more impure. The chief seed used for adulteration is rye-grass. Whatever opinion may be entertained of the value of this grass in pastures, it is obviously undesirable to buy rye-grass as meadow fescue, and pay at least three times its own market price for it. But that this is done to a very great extent is obvious from the following facts. Only twenty-nine per cent. of the samples were free from rye-grass; in thirty-seven per cent. there was less than a quarter of the seeds rye-grass; in twenty-two per cent. there was more than a quarter and less than a half; and in twelve per cent. more than half of the seeds were rye-grass. More than half of the samples (sixty-two per cent.) were above the standard of germination recommended by the Council, and of the remainder, twenty-nine per cent. germinated more than half, while eleven per cent. germinated little more than a quarter. When

one considers the low germination, and the large amount of rye-grass present in so many of the samples, it is manifest that the plants of meadow fescue that actually grow in many pastures must cost a very considerable sum of money.

The smaller fescues, sold under various names, are to a very large extent the seeds of a single species—*Festuca rubra*, Linn. The smaller seeds are generally sold as sheep's fescue, and the larger as hard or red fescue. These seeds are usually pure from adulteration, but the germination is often very low. Thirty per cent. reached the Council's standard, thirty-eight per cent. grew more than a half, though less than the standard, and thirty-two per cent. still lower, one yielding only eight per cent. of germinating seeds.

The samples of cocksfoot (*Dactylis glomerata*, Linn.) were generally pure. Seventy-one per cent. were free from all impurities. Small seeds of rye-grass are the most frequent foreign seeds found in cocksfoot. Eleven per cent. had nearly a third of their bulk composed of small rye-grass seed. Seventy per cent. germinated up to or beyond the Council's standard, in thirteen per cent. more than half the seeds grew, and in seventeen per cent. less than half.

The meadow foxtail (*Alopecurus pratensis*, Linn.), is usually sold pure, though I have met with samples consisting largely of the worthless species, *Alopecurus agrestis*, Linn., which is only a troublesome weed. The samples have often a small proportion of the seeds of *Aira cæspitosa*, Linn., but this is so immature that it is incapable of germination, and, being a very small seed, it need not be taken into account in estimating the impurities in foxtail. The great defect in this seed arises from so large a proportion of it being incapable of germination, because the seed is collected long before it is ripe. This apparently arises from the fact that the flowers of foxtail easily fall off, so that a larger crop can be obtained when it is collected at an early stage, and in this state it also possesses the bright silvery appearance that is sought for by the purchaser. The result is that the germination of this grass is very low. Forty per cent. failed to reach in germination the low standard adopted by the Council, and in only twenty-five per cent. the half of the seeds germinated. This grass is very much infested by a small insect, a species of thrips, which often destroys a large proportion of the seeds. In one case half of the sample was thus destroyed, and only two or three out of fifty-one samples were free from injury by this insect.

The use of fiorin (*Agrostis alba*, var. *stolonifera*) in new pastures is, in my judgment, very doubtful policy, from the danger of introducing ergot with the seed. No less than sixty-five per cent. of

the samples that I have examined have contained a greater or less proportion of this most dangerous parasite. And although I am satisfied that fiorin is a valuable ingredient in grasses for permanent pasture, it would certainly be added at too great a cost if it were the vehicle for introducing ergot into the pasture. The injury to stock caused by ergot is frequently brought under my notice, and in no case where a diligent search in the pastures has been made has it been difficult to find the cause. Like most other maladies, it is easier to prevent than to cure. Fiorin should vary greatly in value in proportion as it is thoroughly cleaned. Some samples that I have examined have had more than half of the bulk consisting of chaff.

The crested dogstail (*Cynosurus cristatus*, Linn.) is seldom adulterated. Two samples have been largely mixed with *Molinia cærulea*, and one with the naked seeds of *Holcus lanatus* (Yorkshire fog). The germination is also generally high. One quarter of the samples examined were below the standard recommended by the Council, and (with the exception of one sample which germinated thirty-five per cent.) only a very little below that standard.

The grass-mixtures that I have analysed strongly support the recommendation of the Seeds and Plant Diseases Committee that it is very undesirable to purchase prepared mixtures. The table on the opposite page shows the composition of sixteen such mixtures, some of which were sold under such high-sounding names as "Landlord and Tenant Mixture," and "Permanent Grasses as recommended by the Royal Agricultural Society." I have added in the last line (000) the composition of the mixture of grasses recommended by Mr. de Laune in his paper published in a recent number of the Society's 'Journal.'

It is difficult to calculate the injury done to a meadow by the introduction of Yorkshire fog (*Holcus lanatus*, Linn.) and the two *Airas* which form so large a proportion of some of the mixtures. When it is desired to lay down a pasture with rye-grass, it could be done at a much cheaper rate than by purchasing a mixture. Several of the impurities present in these mixtures are due to the adulteration of some of the seeds which enter into their composition, or rather to the substitution of one seed for another, thus—*Aira flexuosa* replaces *Avena flavescens*, *Aira cæspitosa* replaces *Agrostis alba*, var. *stolonifera*, and the vernal grass, which should have been *Anthoxanthum odoratum*, in all the mixtures is *Anthoxanthum Puelii*. The Yorkshire fog one would expect to be due to careless collecting or imperfect cleaning; but in the mixtures, in which it is found in considerable quantity, it appears to take the place of foxtail, and has been probably sold for this valuable grass, and paid for accordingly.

COMPOSITION OF SIXTEEN SAMPLES OF GRASS MIXTURE.

Number of sample.	Inferior Grasses.					Better Grasses.							
	Rye Grasses.	Yorkshire Fog.	Aira flexuosa.	Aira cæspitosa.	Other Grasses.	Fescues.	Cocksfoot.	Meadow Grasses.	Foxtail.	Dogstail.	Florin.	Timothy.	Vernal Grass.
116	10	4	..	..	..	3	17	..	..	66	..	..	..
119	10	41	..	..	..	8	29	2	..	8	2	..	..
310	4	2	1	10	..	16	8	25	11	..	3	10	10
311	6	..	4	8	..	..	12	36	4	..	1	12	3
337	50	26	1	..	1	..	2	7	..	9	..	..	1
369	89	5	..	..	..	6	..	..	..	..	..	..	..
370	1	1	27	..	..	37	11	1	8	..	..	..	6
382	5	..	..	..	..	18	18	27	30	..	..	..	2
383	3	2	..	..	..	28	14	32	16	..	..	..	5
415	1	..	..	..	10	15	13	8	33	7	7	6	..
416	49	5	8	..	..	12	3	..	8	..	4	11	..
444	31	..	..	3	3	19	8	27	2	..	..	6	1
448	20	25	..	..	2	3	..	3	20	23	2	2	..
487	62	..	..	..	..	4	18	..	..	..	..	16	..
504	8	..	7	5	11	17	15	8	16	..	1	..	12
505	29	..	..	..	3	32	9	5	10	..	6	..	6
000	..	..	..	..	..	15	16	12	16	7	22	12	..

The only method to prevent the use of seeds which may prove, for years to come, worthless, if not positively baneful in new pastures, is to follow the advice of the Botanical Committee, and, having decided what shall be the ingredients of a mixture, and what the proportions of the various ingredients, to purchase them separately, and to test their purity and germination before sowing.

I have examined sixty-one samples of clovers. They have all been free from the seeds of dodder, and generally free from weeds. Only one case of serious adulteration came under my notice. It was a sample of white clover (*Trifolium repens*, Linn.) which contained fifty-two per cent. of the seeds of hare's-foot clover (*Trifolium arvense*, Linn.), a weed often used for chimney-piece decoration during the winter, because of its long downy heads, but rejected by all kinds of animals. Twenty-eight samples of *Trifolium pratense*, Linn., have been sent to me, half under the name of cow-grass, and the other half as perennial red clover. The greater portion of these were higher than the germination standard recommended by the Council, and the remainder very nearly reached, with the exception of two samples which did not reach, fifty per cent. The samples of alsike were also satisfactory, the larger proportion being up to

the standard of ninety per cent., but only a quarter of the samples of white clover were up to the standard, though none fell below sixty-four per cent.

A good-looking sample of seed-wheat purchased by a member, which failed to come up, was found on trial to be quite dead. The seeds were perfect and well filled, but the embryo had lost its vitality in every case, from the grain having been kept too long. It cannot be sufficiently impressed on sellers and buyers of seeds that wheat usually loses its vitality when kept from six to ten years; and that under special circumstances it may become useless even before it is six years old. No real gain is secured by keeping seed-wheat over the first sowing-time after it has been reaped.

It has been objected by some members of the seed-trade that the germination in the laboratory is a very unsatisfactory test of the growing-value of the seed. It is asserted that much better results are to be had from the sowing under natural conditions in the field than can be obtained by the artificial conditions under which germination is usually tested. These statements are very plausible, but they are utterly wrong. The conditions necessary to the germination of a seed are all secured in a proper testing-case, and none of the accidents which cause the death of the seed or of the young plant are permitted. Too deep immersion in the soil, too little water, too much sun, the attacks of insects, and other conditions met with in the field, or even in an experimental plot, are avoided in the laboratory. But the actual experiments of Dr. Sturtevant, the Director of the New York Agricultural Experimental Station, have established beyond controversy that the proportion of seeds from the same sample which vegetate in the garden are considerably smaller than those that manifest vitality in a germinating apparatus. The test of germination is really a test of the seed's vitality. The first evidence of this is the sending out of the rootlet. And the appearance of the radicle or rootlet is sufficient to determine the capacity of the seed to germinate. The tender plant may have a short supply of food in the seed, or it may have difficulty in getting such a hold of the soil as to obtain food for itself, or many things may happen to arrest its progress and cause early death. Dr. Sturtevant found no constant relation between the percentage of seeds which germinated in the laboratory and those which produced young plants in the garden. In some exceptional cases, seeds, every grain of which germinated in the laboratory, were unable to produce a single plant in the field. Such cases were met with only in respect of some seeds which were very long in vegetating, and were consequently subject to more accidents, and the attacks of more

enemies, than seeds which grew quickly. The results he obtained will be more manifest by one or two illustrations. The average of six experiments with cauliflower-seeds two years old gave eighty-seven per cent. for germination, and fifty-four per cent. for vegetation; thirteen experiments with three-year-old mustard-seed gave an average of eighty-nine per cent. for germination, and sixty per cent. for vegetation; and six experiments with three-year-old mustard-seed gave an average of ninety per cent. for germination, and seventy-four per cent. for vegetation.

These experiments make perfectly plain what was obvious theoretically, that a certain deduction must be made from the germinating power in estimating the actual number of plants which will be produced in the field. And the deduction must be greater in small seeds, like the meadow grasses (*Poa*) and fiorin (*Agrostis*), and in imperfectly ripened seeds like those of meadow foxtail (*Alopecurus*) and yellow oat-grass (*Avena*).

I have contributed a paper on some adulterations in grass-seeds to the last number of the 'Journal.' The paper previously published in the 'Journal' on wheat-mildew has been reprinted by the Indian Government, and extensively circulated among the wheat-growers in India. Correspondence in connection with the diseases of wheat in India, and arising out of the distribution of this paper, has been sent to me from the India Office. I have supplied suggestions for further inquiries, which may lead to important results connected with the agriculture of India.

XI.—*Report on the Field and Feeding Experiments at Woburn, conducted on behalf of the Royal Agricultural Society of England during the year* 1883. By Dr. AUGUSTUS VOELCKER, F.R.S., Consulting Chemist to the Society.

THE means adopted last year to keep the land on which wheat and barley are grown continuously free from weeds were again found necessary to be employed, and resulted, as then, in the land being kept perfectly clean, and in good condition.

EXPERIMENTS ON THE CONTINUOUS GROWTH OF WHEAT.

On August 29th, the permanent wheat-land was ploughed for the first time, and twitched and ploughed a second time on October 13th. Nine pecks of Browick wheat, the variety and quantity used in previous years, were dibbled and harrowed in on October 19th.

On October 11th, four bullocks were put into the feeding-boxes, to make the farmyard-manure for the permanent wheat-plots to be manured with dung. The bullocks finished making the dung on November 4th, having in this period of three weeks and three days consumed 2 cwt. 2 qrs. of decorticated cotton-cake, 4 cwt. of maize-meal, 30 cwt. of sliced white turnips, and 5 cwt. of wheat-straw chaff as food; using also 12 cwt. of wheat-straw as litter.

The following Table gives the weight of the bullocks when put in on October 11, and on their removal on November 4th.

	When put up, on Oct. 11, 1882.			When removed, on Nov. 4, 1882.			Gain from Oct. 11 to Nov. 4, three weeks and three days.		
	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
Bullock No. 1 weighed	10	0	7	10	1	17	0	1	10
„ No. 2 „	10	3	22	11	1	6	0	1	12
„ No. 3 „	9	0	5	9	2	17	0	2	12
„ No. 4 „	11	0	12	11	0	9	loss 0	0	3
Total weight of 4 Bullocks ..	41	0	18	42	1	21	1	1	3

The bullocks began feeding with 30 lbs. of roots per day, and other food in proportion, finishing off at 40 lbs. of roots per day. Bullock No. 4 was ill for three days, and refused to eat, in consequence of which it lost 3 lbs. The others did well, especially No. 3.

The following Table shows the composition of the decorticated cotton-cake and maize-meal given to the bullocks in these experiments:—

	Decorticated Cotton-cake.	Maize-meal.
Moisture	10·25	14·29
Oil	16·86	4·46
*Albuminous compounds	40·50	10·75
Mucilage, sugar, digestible fibre, &c.	21·88	66·24
Woody fibre (cellulose)	4·41	1·51
Mineral matter (ash)	6·10	2·75
	100·00	100·00
* Containing nitrogen	6·48	1·72

The decorticated cotton-cake was of very high quality, and contained nearly 6 per cent. more oil than that used in the

similar experiments of last year. The composition of the turnips used was—

Water	92·80
*Albuminous compounds	0·77
Sugar, woody fibre, &c.	5·88
Mineral matter (ash)	0·55
	100·00
* Containing nitrogen	·12

The amount of nitrogen in the wheat-straw chaff was ·77 per cent., equal to 4·81 per cent. of albuminous compounds. The dung was removed from the pits on November 13th, and left covered until January 24th, 1883, when it was found to weigh 33 cwt. 1 qr. 26 lbs. On to one-half of Plot 10, a quantity of dung, calculated to contain nitrogen equal to 100 lbs. of ammonia per acre, was applied, and double that quantity to one-half of Plot 11.

The mineral manures were sown broadcast on February 16th, and the nitrogenous top-dressings on April 13th. November was wet and stormy, followed by frost and snow in the early part of December, after which milder weather set in, and the wheat began to appear above ground. In the beginning of January the wheat was growing well, any gaps in it being filled up this month. Heavy rains followed towards the close of January and commencement of February: 2·26 inches of rain having fallen in January, and ·75 inch in the two first days of February. The wheat at the latter date looked fairly well, but was attacked in places by a small white grub,—the wheat of several farmers in the neighbourhood being similarly attacked. The total rainfall for February was 2·98 inches, and for the period of six months, 17·95 inches. A week's frost succeeded early in March, and left the land in an improved state; only ·89 in. of rain fell in March, and the land worked splendidly. The wheat, however, looked rather cut down. On April 3rd, it was hoed and pressed with the Cambridge roller, and that which had been dibbled in to fill gaps in January had now come up well also. On April 13th the nitrogenous top-dressings of salts of ammonia and nitrate of soda were sown by a broadcast manure-distributor, after having been diluted with about three times their bulk of dry sand. The wheat was now cross-hoed. About this time wireworms began to appear. Any gaps in the wheat were filled up on April 28th. Wireworms again came up at the close of April, and slightly attacked all the plots. At the opening of May the plant looked healthy, and the ground was fairly clean. Rain, however, following, the weeds came up very fast, and were very hard to get rid of, the ground not being dry enough to hoe.

Hot weather followed in June, and the wheat progressed well, coming into bloom in the last week, and showing a large ear. Heavy rains fell in July, accompanied by frequent storms, and the wheat got considerably knocked about, especially Plots 8 and 9. The maggot also began to appear to some extent. In August the weather improved greatly, and the wheat came on well. Inspecting the crops on August 3rd, 1883, I made the following notes on the permanent wheat:—

Plot 1 (unmanured). Wheat healthy, and promising rather better than the second unmanured plot 7.

Plot 2 (ammonia-salts alone). Wheat blighted in places.

Plot 3 (nitrate of soda alone). Wheat rather better than plot 2.

Plot 4 (minerals alone). No better than unmanured plots, except under a large tree, where the falling leaves no doubt manured the land.

Plot 5 (minerals and 200 lbs. of ammonia-salts). Wheat fine, except on small plants, the ears of which are blighted.

Plot 6 (minerals and small quantity of nitrate of soda). Wheat healthy, and apparently a big crop. Probably will yield as well as any.

Plot 7 (unmanured). Wheat looks better than in any previous year.

Plot 8A (minerals and 400 lbs. of ammonia-salts). Very heavy crop, a good many of the shorter stems have the ears blighted. The wheat has not gone down.

Plot 8B (minerals alone, ammonia-salts left out in 1883). No better than, if so good as, the unmanured plots.

Plot 9A (minerals and large quantity of nitrate of soda). Rather better than 8A, but attacked by red rust.

Plot 9B (minerals alone, nitrate of soda left out in 1883). A little better than 8B.

Plot 10A (no dung in 1883, for the second year). Decidedly better than plots 1 and 7.

Plot 10B (small quantity of dung every year). Wheat good.

Plot 11A (no dung in 1883, for the second year). Good.

Plot 11B (large quantity of dung every year). Wheat much better than plot 11A.

From August 18th to 25th, a week of perfect harvest weather followed, and the cutting of the wheat commenced on August 21st, continuing for a week, all not being ready to cut at once. The carting commenced on September 5th, and all was stacked by September 14th. The threshing took place in the field on October 23rd. The straw of the several plots was at once weighed in the field, and the corn put in sacks and stored in the granary until November 1st, when it was weighed with

every possible accuracy by a trained chemist, the single bushels and the whole produce being separately weighed.

In Table I. (p. 342) are given the manurial treatment of each plot, and the produce per acre of corn and straw.

On all the plots except those to which farmyard-manure was applied, the produce of straw was below that yielded in 1882. The produce of corn was in every case, except that of plots 2 and 5, higher than the results obtained in 1882 by similar treatment. On the unmanured plots the increase was 243 lbs. and 354 lbs. respectively. Where ammonia-salts and nitrate of soda respectively were applied in conjunction with mineral manures, there was a difference of 415 lbs. per acre in favour of nitrate of soda over last year's produce, the ammonia-salts giving 92 lbs. less, and the nitrate of soda 323 lbs. more than in 1882. Similarly, when these salts were applied alone, without minerals, the nitrate of soda gave about the same produce as before, while that of the ammonia-salts was less by 462 lbs. It would appear from this that nitrate of soda had this season been more beneficial to the wheat than ammonia-salts, though, as in previous seasons, the use of superphosphate in conjunction with them showed marked improvement over the results obtained by either salt alone.

Passing next to the half plots 8A and 8B, on which the treatment adopted in 1882 was reversed, the addition of 400 lbs. of ammonia-salts, with minerals, to plot 8A, previously manured last year with minerals alone, produced an increase of nearly 2000 lbs. of corn per acre, while the effect of leaving them off, and using minerals alone on plot 8B, was also very marked, the produce falling from 2568 lbs. to 996 lbs. per acre. Similar results were shown with nitrate of soda used at the rate of 550 lbs. per acre. Its application with minerals to plot 9A, manured last year with minerals alone, increased the produce by 1846 lbs., while its omission on plot 9B, where minerals and nitrate had been used in 1882, lowered the produce in the single year by 1000 lbs. per acre. The larger quantity of nitrate of soda does not appear to have shown its superiority over the ammonia-salts in the same way as in the case of the smaller quantities. In the cases in which ammonia-salts and nitrate of soda were omitted, the produce fell in a single year to the average of the unmanured plots, showing that the effect of these nitrogenous top-dressings is confined to the year of their application. On the plots to which farmyard-manure was applied, either continuously every year or previously to 1882, there was an increase in each case, this being the more marked in the continuously manured plots, of which 11B, manured with the larger quantity of dung, continued to give the higher produce. These results

TABLE I.—PRODUCE OF CONTINUOUS WHEAT. SEVENTH SEASON, 1883.

Plots.	Manures per Acre.	Produce per Acre. Dressed Corn. Weight.	Number of Bushels.	Weight per Bushel.	Straw, Chaff, &c. cwts.	qrs.	lbs.
		lbs.		lbs.	cwts.	qrs.	lbs.
1	Unmanured	943	16	58·9	17	2	16
2	200 lbs. ammonia-salts alone (applied in the spring)	1404	24·1	58·2	27	0	4
3	275 lbs. nitrate of soda (applied in the spring)	1498	27·5	54·1	28	3	16
4	200 lbs. sulphate of potash, 100 lbs. sulphate of soda, 100 lbs. sulphate of magnesia, 3½ cwts. superphosphate of lime	1013	17·3	58·4	17	3	10
5	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 200 lbs. ammonia-salts (in spring)	2006	34·2	58·7	36	1	26
6	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 275 lbs. nitrate of soda (in spring)	2233	38·1	58·6	37	3	2
7	Unmanured	1090	18·5	58·8	18	2	4
8A	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 400 lbs. ammonia-salts in 1883	2762	45·8	60·3	47	1	12
8B	The same minerals as in 8A, no ammonia-salts in 1883	996	17·3	57·6	13	3	16
9A	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 550 lbs. nitrate of soda (in spring, 1883)	2534	43·8	57·8	47	0	8
9B	The same minerals as in 9A, no nitrate of soda in 1883	1100	18·6	59·0	17	3	12
10A	No manure (having received manure as 10B in each of the five seasons previous to 1882, but none in 1882)..	1186	19·9	59·6	23	1	4
10B	Farmyard-manure, estimated to contain nitrogen = 100 lbs. ammonia, made from 672 lbs. decorticated cotton-cake, 1075 lbs. maize-meal, 8064 lbs. turnips, 1344 lbs. wheat-straw, as food; and 1747 lbs. wheat-straw as litter. Weight about 4 tons	1670	27·9	59·7	29	2	4
11A	No manure (having received manure as 11B in each of the five seasons previous to 1882, but none in 1882)..	1292	21·2	60·8	21	3	8
11B	Farmyard-manure, estimated to contain nitrogen = 200 lbs. ammonia, made from 1344 lbs. decorticated cotton-cake, 2150 lbs. maize-meal, 16,128 lbs. turnips, 2688 lbs. wheat-straw chaff, as food; and 3494 lbs. wheat-straw as litter. Weight about 8 tons ..	2026	33·5	60·5	37	1	12

show that, even after a lapse of two years, the farmyard-manure applied previously to 1882 has left in the land some unexhausted fertilising matters which told upon the produce of the wheat crop of 1883.

EXPERIMENTS ON THE CONTINUOUS GROWTH OF BARLEY.

The land devoted to these experiments was ploughed for the first time on September 1st, the ground having been first well twitched. Four bullocks, to make the dung for the plots which were to receive farmyard-manure, were put into the feeding boxes on October 11th, and finished making the dung on November 4th. In this period of three weeks and three days the bullocks consumed:—

	cwts.	qrs.	lbs.
Decorticated cotton-cake	2	2	0
Maize-meal	4	0	0
Sliced white turnips	30	0	0
Wheat-straw chaff (as food)	5	0	0

Besides which, they used 12 cwt. of wheat-straw chaff as litter.

The following table shows the weights of the bullocks, separately and collectively, when put in on October 11th, when removed on November 4th, and the increase in live-weight obtained during the period of feeding:—

	When put in, on Oct 11, 1882.			When removed, on Nov. 4.			Gain in live-weight, from Oct. 11 to Nov. 4, (three weeks and three days).		
	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
Bullock No. 1 weighed	9	0	22	9	1	26	0	1	4
„ No. 2 „	9	3	26	10	1	24	0	1	26
„ No. 3 „	10	1	11	10	3	1	0	1	18
„ No. 4 „	9	3	4	10	1	4	0	2	0
Total weight of 4 Bullocks ..	39	1	7	40	3	27	1	2	20 Total increase

The bullocks were fed at first with 30 lbs. of roots per day, and the other food in proportion, and finished off with 40 lbs. of roots per day. With the exception of bullock No. 1, the animals increased uniformly. The composition of the various foods has been already given on page 338.

The dung was removed from the pits on November 13th, and left covered until January 24th, 1883, when it was weighed. The total weight of dung obtained was 32 cwt. 1 qr. 16 lbs. To one half of plot 10 a quantity of dung, calculated to contain nitrogen equal to 100 lbs. of ammonia per acre, was applied on

that day, and double that quantity (equal to 200 lbs. of ammonia per acre) to one-half of plot 11.

On March 16th the land was ploughed a second time, and on March 31st the seed, Oakeshott's Golden Melon Barley, was sown at the rate of 9 pecks per acre, the mineral manures being sown at the same time, just in front of the drill. The nitrogenous top-dressings of ammonia-salts and nitrate of soda were sown on April 25th, after having been mixed with about three times their bulk of dry sand, and distributed by a broadcast manure distributor.

The land was rolled on May 2nd, and hoeing it began on May 9th. The fine weather of June caused the barley to grow well, and on June 30th it began to come out well, being healthy and even. The succeeding wet weather and storms of July seemed to do the barley more damage than the wheat; and on several plots, especially plots 8 and 9, it was much storm-twisted. At the end of July it appeared much beaten down, and sunshine was badly needed. Plot 6 (nitrate of soda) and plot 11 (heavily dunged), in addition to the ones already mentioned, did not stand well. The improved weather in August caused a welcome change, and on inspecting the plots on August 3rd I made the following notes:—

Plot 1 and plot 7 (unmanured). Barley looks well; somewhat thin, but better than plot 4, on which minerals alone had been sown.

Plot 2 (ammonia-salts alone). A fine crop.

Plot 3 (nitrate of soda alone). A good crop, and rather better than plot 2.

Plot 5 (minerals and ammonia-salts). Almost the best crop of all.

Plot 6 (minerals and nitrate of soda). Heavier crop than Plot 5, but barley very much twisted, and partly down on the ground.

Plot 8A (minerals, and large quantity of ammonia-salts). A heavy crop, but barley much laid down, though not as much as on plot 9A.

Plot 8B (minerals alone). Barley standing well up, and rather better than plot 9B.

Plot 9A (minerals, and large quantity of nitrate of soda). Very heavy crop, but much laid. The barley went down first on this plot.

Plot 9B (minerals alone). Barley healthy, and better than on unmanured plots.

Plot 10A (no dung for last two years). Barley good.

Plot 10B (small quantity of dung every year). Better, though not much, than plot 10A.

Plot 11A (no manure for last two years). Barley good, standing up well.

Plot 11B (large quantity of dung every year). Barley heavy, about one-half down on ground.

The fine weather of August caused the barley to come on better, and on August 21st and five following days it was cut. Carting began on September 7th, but rain prevented all being got in at once. By September 14th all the barley had been carted, stacked, and thatched. It was threshed in the field on October 25th, the straw being at once weighed. The corn was stored and weighed on November 2nd, the same precautions being adopted as in the case of the permanent wheat.

Table II. (p. 346) shows at once the different treatment of the several plots, with the resulting produce of corn and straw obtained in 1883.

The barley crop in 1883 at Woburn was rather above an average crop. One of the two unmanured plots upon which barley had been grown in succession in the preceding six years produced 30·3 bushels of dressed barley, weighing nearly 53 lbs. per bushel, and 18 cwts. 2 qrs. 14 lbs. of straw per acre; the second unmanured plot (plot 7) produced 22·8 bushels of dressed barley and 13 cwts. 3 qrs. 22 lbs. of straw per acre, confirming the experience of previous years, and showing that plot 1 is naturally more productive than plot 7. The average produce of the two unmanured plots, Nos. 1 and 7, in round numbers amounted to 26·5 bushels of dressed barley, and 16 cwts. 1 qr. 4 lbs. of straw per acre.

Ammonia-salts alone (plot 2) and nitrate of soda alone (plot 3) largely increased the crops, the former giving an increase of 24·1 bushels per acre over the average produce of the two unmanured plots, and the latter an increase of 24·6 bushels. It will also be seen that nitrate of soda alone on plot 3 gave a heavier crop of straw than the ammonia-salts alone on plot 2.

The minerals alone on plot 4, as in previous years, had no effect on the yield of corn or straw in 1883. The addition of nitrate of soda to minerals on plot 6 had the effect of raising the produce in barley to nearly 56 bushels per acre, and that of straw to 2 tons 3 cwts. 2 qrs. 16 lbs.

In conjunction with minerals, ammonia-salts on plot 5 also gave a large increase both of corn and straw, but the increase in straw on plot 5 was less conspicuous than on plot 6, manured with minerals and nitrate of soda.

In the five years previous to 1882, plots 8 and 9 had been annually manured with a heavy dressing of mineral manures, and a large dose of ammonia-salts; or with minerals and nitrate of soda. In 1882 these plots were divided into two

TABLE II.—PRODUCE OF CONTINUOUS BARLEY. SEVENTH SEASON, 1883.

Plots.	Manures per Acre.	Produce per Acre. Dressed Corn. Weight.	Number of Bushels.	Weight per Bushel.	Straw, Chaff, &c.		
		lbs.		lbs.	cwts.	qrs.	lbs.
1	Unmanured	1596	30·3	52·7	18	2	14
2	200 lbs. ammonia-salts, alone	2684	50·6	53·0	30	1	4
3	275 lbs. nitrate of soda, alone	2708	51·1	53·0	37	1	4
4	200 lbs. sulphate of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime	1470	28·0	52·5	17	1	20
5	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. superphosphate of lime, and 200 lbs. ammonia-salts	2810	50·9	55·2	32	1	26
6	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulphate of magnesia, 3½ cwts. of superphosphate of lime, and 275 lbs. nitrate of soda	2948	55·8	52·8	43	2	16
7	Unmanured	1281	22·8	51·6	13	3	22
8A	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. of superphosphate of lime, and 400 lbs. ammonia-salts in 1883 ..	3368	62·5	53·9	32	1	8
8B	The same minerals as in 8A, no ammonia-salts in 1883	1914	35·2	54·3	19	3	0
9A	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. of superphosphate of lime, and 550 lbs. of nitrate of soda in 1883	3126	60·9	51·3	49	3	12
9B	The same minerals as in 9A, no nitrate of soda in 1883	1944	35·9	54·2	22	0	16
10A	No manure (having received manure as 10B in each of the five seasons previous to 1882, but none in 1882) ..	1746	33·4	52·2	17	2	12
10B	Farmyard-manure, estimated to contain nitrogen = 100 lbs. of ammonia, made from 672 lbs. decorticated cotton-cake, 1075 lbs. maize-meal, 8064 lbs. turnips, 1344 lbs. wheat-straw chaff, as food; and 1747 lbs. wheat-straw as litter. Weight about 4 tons	2038	38·8	52·5	22	3	20
11A	No manure (having received manure as 11B in each of the five seasons previous to 1882, but none in 1882) ..	1982	38·0	52·2	24	3	24
11B	Farmyard-manure, estimated to contain nitrogen = 200 lbs. ammonia, made from 1344 lbs. decorticated cotton-cake, 2150 lbs. maize-meal, 16,128 lbs. turnips, 2688 lbs. wheat-straw chaff, as food; and 3494 lbs. wheat-straw as litter. Weight about 8 tons ..	2710	51·3	53·1	34	1	12

equal halves of one-eighth of an acre each; on one half of plot 8 (plot 8A) the usual quantity of mixed minerals alone was employed, and on the second half the same quantity of mixed minerals, with the addition of 400 lbs. of ammonia-salts, were used.

On plot 9A mixed minerals alone, and on plot 9B minerals, with the addition of 550 lbs. of nitrate of soda per acre, were applied. In 1883 the treatment, as regards manures, adopted in 1882 was reversed, and plot 8A was dressed with minerals and ammonia-salts, and plot 8B with minerals only. Similarly plot 9A was dressed with minerals and nitrate of soda, and plot 9B with minerals only.

The results of the experiments with the manures on plots 8A and 8B, and 9A and 9B, in 1883 are highly instructive. The plot 8A, dressed in 1882 with minerals alone, gave 37·7 bushels of dressed barley, and 1 ton 5 cwts. 26 lbs. of straw; and last season, dressed with minerals and the addition of ammonia-salts, it yielded 62½ bushels and 1 ton 12 cwts. 1 qr. 8 lbs. of straw; whilst plot 8B in 1882, dressed with minerals and ammonia, and yielding 52·7 bushels of barley, produced last season, when dressed with minerals alone, only 35·2 bushels and 19 cwts. 3 qrs. of straw. A similarly large increase was obtained in 1883 on plot 9A by the addition of nitrate of soda to minerals. This plot, it will be seen, yielded nearly 61 bushels of corn, and 2 tons 9 cwts. 5 qrs. 12 lbs. of straw; whilst in the preceding year, when manured with minerals alone, the same plot produced only 37 bushels of corn, and 19 cwts. 20 lbs. of straw.

On the other hand, plot 9B, dressed in 1883 with minerals alone, gave only 35·9 bushels of corn, and 1 ton 2 cwts. 16 lbs. of straw; whereas the same plot in the preceding year, when dressed with minerals and nitrate of soda, yielded 66·8 bushels of barley, and 2 tons 8 cwts. 3 qrs. 14 lbs. of straw.

Previous to 1882 the barley on plot 10 was grown for five years in succession with well-rotten dung, calculated to contain 100 lbs. of ammonia, and on plot 11 with dung calculated to contain 200 lbs. of ammonia. With a view of studying the lasting effects of farmyard-manure, and the probable increased fertility of land annually manured with good dung, plots 10 and 11 were divided in 1882 into two equal halves. From one half of these plots the dung was withheld for the first time in 1882, and again last season; whilst on the second halves the supply of the usual annual quantity of well-rotten dung was continued. It appears that, although no dung had been applied on plots 10A and 11A for the last two years, the influence of the residue of the five previous dungings was clearly perceptible in the yield of the barley on those two plots, to a

slighter extent on plot 10A than on plot 11A, to which double the quantity of dung had been applied previous to 1882. On plot 11A, a crop of 38 bushels of barley was grown, although no dung had been applied to it since 1881, or almost as much as had been produced on plot 10B, annually manured with small quantities of dung. The produce of the larger dose of dung on plot 11B, it will be seen, was very satisfactory, as it amounted to 51·3 bushels, weighing 53·1 lbs. per bushel, and gave an increase of 24·8 bushels over the average produce of the two unmanured plots Nos. 1 and 7.

The Experiments in Rotation.

Rotation No. 1.—1877, seeds; 1878, wheat; 1879, mangolds; 1880, barley; 1881, seeds; 1882, wheat.

Swedes, 1883.—The land was ploughed for the first time on Sept. 4th. The dung for the swedes was made by 8 bullocks, which were put into the feeding-boxes on November 21st, and which finished making the manure for plots 2, 3, and 4 on January 19th, having occupied 8 weeks and 3 days, and for plot 1 on January 21st, a period of 8 weeks and 5 days.

During these periods the bullocks consumed the following amounts of food: 2 bullocks (for plot 1) consumed 923 lbs. of decorticated cotton-cake, 5000 lbs. of mangolds, and 1250 lbs. of wheat-straw chaff; two others (for plot 2) consumed 1000 lbs. of maize-meal in place of decorticated cotton-cake; while four others (for plots 3 and 4) received only the mangolds and wheat-straw chaff, all eight bullocks having been alike supplied with 1880 lbs. of wheat-straw chaff as litter. The following Table gives the weights of the bullocks when put in the feeding-boxes on November 21st, and when removed on January 19th and 21st, as well as the increase of live-weight in the period of feeding:—

	When put in, on Nov. 21.			When removed, on Jan. 21.			Increased in live-weight, from Nov. 21 to Jan. 21.		
	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
2 Bullocks, 1 and 2, receiving decorticated cotton-cake as additional food	20	1	7	21	0	10	0	3	3
				On Jan. 19.			To Jan. 19.		
2 Bullocks, 7 and 8, receiving maize-meal as additional food	20	3	21	22	1	19	1	1	23
2 Bullocks, 3 and 4, fed without cake or corn	19	1	15	19	0	9	loss	1	6
2 Bullocks, 5 and 6, fed without cake or corn	18	1	18	18	3	7	0	1	17

Bullock No. 2 went off its feed once for three days, and did not seem to like the decorticated cotton-cake, but its companion got the benefit of the extra lot. Bullocks 3 and 4 lost slightly, and 5 and 6 gained slightly. The bullocks 7 and 8, which were fed upon maize-meal as additional food, gained most in weight. The dung was taken out of the pits as soon as the feeding was over, and kept under cover until March 24th, when it was carted on to the field and ploughed in.

On April 3rd the land was drag-harrowed. The mineral manures were sown on plots 3 and 4 on May 24th, and the seed, 3 lbs. of Gibbs's selected purple-top swede per acre, was drilled in on May 25th. On June 1st the land was horse-hoed, and the plants were singled out on June 12th. Horse-hoeing was done on June 27th, and hand-hoeing on June 30th. The nitrate of soda was sown by hand round the swedes on July 9th. In the middle of July the swedes looked even and free from disease. Towards the end of the month they looked well, except on plot 3 (heavily manured with nitrate of soda), where many were thistle-headed. Plot 4 was somewhat so likewise.

Inspecting the plots on August 3rd, I made the following notes: The larger quantity of nitrate of soda on plot 3 shows well, and also the smaller quantity of nitrate on plot 4. On both plots, however, some plants are thistle-headed, that is to say, there are several small heads instead of one true head, which is not the case where no nitrate was used. On the maize-meal plot (No. 2) the swedes look almost as well as on plot 3; and the decorticated cotton-cake plot (No. 1) shows decidedly the best appearance of all. On November 3rd the roots were taken up, and showed a heavy crop, the roots being very sound. These were topped and tailed and weighed on November 24th, 1882, the weights being recorded in Table III. (p. 350).

The heaviest crop by far was that of plot 3, grown with artificial manures containing the equivalent of all the mineral, and two-thirds of the nitrogenous constituents contained in 1000 lbs. of decorticated cotton-cake. The next best was plot 4. These results were in direct accord with those obtained in rotation 4 in 1882, though in 1883 all the crops were considerably heavier than in the year previous, both as regards roots and leaves.

Rotation No. 2.—Four acres. 1877, mangolds; 1878, barley; 1879, seeds; 1880, wheat; 1881, mangolds; 1882, barley; 1883, seeds.

Seeds, 1883.—The seeds, Dutch white clover, were sown among the barley on June 6th, 1882. In February 1883 the crop was standing well, and on May 2nd it was rolled;

TABLE III.—PRODUCE OF SWEDES, 1883 (ROTATION No. 1), AFTER WHEAT.

Plots of One Acre.		Produce per Acre. Roots.				Leaves.			
		tons.	cwt.	qrs.	lbs.	tons.	cwt.	qrs.	lbs.
1	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. decorticated cotton-cake	20	0	1	27	3	3	1	8
2	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. of maize-meal	20	4	0	12	2	19	3	14
3	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff; and artificial manure, containing two-thirds as much nitrogen, and the other constituents, of the manure from 1000 lbs. decorticated cotton-cake; namely, 248 lbs. nitrate of soda, 100 lbs. of bone-ash (made into superphosphate), 62½ lbs. sulphate of potash and 65 lbs. sulphate of magnesia	23	6	3	24	3	1	1	0
4	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff; and artificial manure, containing as much nitrogen, and other constituents, as the manure from 1000 lbs. maize-meal; namely, 80 lbs. nitrate of soda, 16¼ lbs. bone-ash (made into superphosphate), 7 lbs. sulphate of potash, and 11 lbs. sulphate of magnesia	20	13	1	4	2	16	2	8

40 sheep, 10 on each plot of 1 acre, were put on for the first time on May 29th; there was so much food to consume that the sheep ate it down but slowly. However, pen 1 finished on July 2nd, pen 2 on July 14th, and pens 3 and 4 on July 17th. They were put on a second time on July 17th, and finally a third time on September 15th. The 10 sheep forming pen 1 received as additional food ½ lb. decorticated cotton-cake per head per day, and the 10 in pen 2, ½ lb. of maize-meal per head per day as additional food.

The following statement shows the weights of the sheep when put on the clover on May 29th, and the increase in lbs. after going over it for the first time:—

Plots.		When put on, May 29.	When taken off.	Increase in Live-weight.
		cwts. qrs. lbs.	cwts. qrs. lbs.	lbs.
1	Fed-off by 10 sheep, each sheep receiving about ½ lb. decorticated cotton-cake per day; 10 sheep on the land 34 days ..	11 0 6	July 2. 12 2 15½	177½
2	Fed-off by 10 sheep, each sheep receiving about ½ lb. of maize-meal per day; 10 sheep on the land 46 days	11 0 5	July 14. 12 2 14	177
3	Fed-off by 10 sheep, without other food; 10 sheep on the land 49 days	11 0 6¾	July 17. 12 1 7¾	141
4	Fed-off by 10 sheep, without other food; 10 sheep on the land 49 days	11 0 6¾	July 17. 12 2 26¾	188

These variations in the weights were due in great measure to the difference in the luxuriance of the clover crops. Plot 1 was very weak, being partly killed by the heavy crop of barley in 1882. Plot 2 had suffered less; on both the clover was in bloom and running to seed when the sheep were put on it. The food was so rich, that the sheep did not want any additional food. On plots 3 and 4 the keep got a little old and stale at the finish, and the sheep would not eat it down enough. The crop of plot 4 was better than that of plot 3; the nitrate had forced the barley on plot 3, and this had thinned the clover. On taking the sheep off the clover for the second time on August 27th and weighing them, the following results were obtained:—

Plots.		When put on, July 17.	When taken off, Aug. 27.	Increase in Live-weight.
		cwts. qrs. lbs.	cwts. qrs. lbs.	lbs.
1	Fed-off by 10 sheep, eating about ½ lb. of decorticated cotton-cake per sheep per day; on land 41 days	12 1 19	12 2 4½	13½
2	Fed-off by 10 sheep, eating about ½ lb. of maize-meal per day; on land 41 days	12 2 9¾	12 1 5¾	− 32
3	Fed-off by 10 sheep, without other food; on land 41 days	12 1 7¾	12 0 18½	− 17¼
4	Fed-off by 10 sheep, without other food; on land 41 days	12 2 26¾	12 2 4	− 22¾

All did very badly, the food got stale before it was done, and unfortunately foot-rot broke out. The sheep were put on the clover a third time on September 14; those in pens 3 and 4 finished on October 6th, and the rest on October 9th, when the results were:—

Plots.		When put on, Aug. 27.			When taken off, Oct. 9.			Increase in Live-weight.
		cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	lbs.
1	Fed-off by 10 sheep, receiving decorticated cotton-cake; on land 23 days	12	0	2	12	2	21¼	75¼
2	Fed-off by 10 sheep, consuming maize-meal; on land 23 days	11	3	23¼	12	2	5	65¾
3	Fed-off by 10 sheep, without additional food; on land 20 days	11	2	26	Oct. 6. 11	1	24¾	− 29¼
4	Fed-off by 10 sheep, without additional food; on land 20 days..	11	3	1¾	Oct. 6. 11	3	25¾	24

The following statement is a summary of the results, and shows the number of sheep fed on each acre, the quantity of purchased food consumed (if any), the number of days the animals were kept on the land, and the total increase in live-weight yielded—

Plots.		Increase in Live-weight. lbs.
1.	Fed-off by 10 sheep, with 672 lbs. decorticated cotton-cake; on land 98 days	266¼
2.	Fed-off by 10 sheep, with 728 lbs. of maize-meal; on land 110 days	210¾
3.	Fed-off by 10 sheep, without other food; on land 110 days	94½
4.	Fed-off by 10 sheep, without other food; on land 110 days	189¼

Rotation No. 3.—Four acres. 1878, seeds; 1879, wheat; 1880, mangolds; 1881, barley; 1882, seeds; 1883, wheat.

Wheat, 1883.—The land, upon which clover had been fed off by sheep in 1882, was ploughed up on October 10th, 1882, and harrowed on October 23rd, on which latter day the wheat (Browick wheat), at the rate of 8 pecks per acre, was drilled in. It came up well, and continued to grow favourably through the winter, all gaps in it being filled up in January. Early in February it was attacked by a white grub, and was on February 26th rolled with a Cambridge roller in the hope of killing these. The

mineral manures for plots 3 and 4 were sown on February 17th. On April 3rd the land was again pressed; it was horse-hoed and harrowed on the 10th; the wheat then looked very clean, and on that day the nitrogenous top-dressings were sown on plots 3 and 4.

The attacks of the wireworm were felt at the close of April, and the heavy rain of May caused the weeds to come up badly. At the close of June the wheat came into bloom, showing a good ear, but the storms of July did a good deal of mischief. The red maggot did not appear to such an extent as in the case of the permanent wheat. Visiting the plots on August 3rd, after an improvement in the weather, I remarked on the plots as follows:—

Plot 1 (decorticated cotton-cake plot). Wheat splendid; apparently the best of the four plots.

Plot 2 (maize-meal plot). Nearly as good as plot 3.

Plot 3 (large quantity of nitrate of soda). Wheat taller than on plot 4 (small quantity of nitrate of soda)—not so well matured as on the other three plots; wheat 5ft. 5in. high.

In August the wheat got rapidly ripe, and was cut on August 27th. Carting took place on September 4th and 5th, and the wheat was threshed in the field on October 23rd and 24th. The corn, after a short storing, was winnowed and weighed on November 1st, the yields of corn and straw being shown in Table IV. (p. 354).

Compared with last year the yield in 1883 was higher, but on each plot there was a very much larger quantity of tail-corn than then; the straw, on the other hand, was somewhat less. The same differences noted in 1882 were again visible now, plot 3 again showing the poorest yield and the largest amount of tail-corn. Between the total yields of the other 3 plots there was not much to choose, the number of bushels, taking head and tail corn together, being in each case 46 and a fraction.

Rotation No. 4.—Four acres. 1878, mangolds; 1879, barley; 1880, seeds; 1881, wheat; 1882, swedes; 1883, barley.

Barley, 1883.—The swedes grown on the land in 1882 were fed off on the field by sheep, which were put on the swedes on November 29th and which finished on March 26th. The land was then ploughed up at once; and the seed, 8 pecks of Oakeshott's Golden Melon per acre, was drilled in on March 30th and 31st. The nitrogenous top-dressing was sown on April 21st. The land was hoed on May 10th, and on the 18th white Dutch clover was sown between the barley.

The previous swede crop of 1882 had been manured as follows:—

PLOT 1.—With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. decorticated cotton-cake.

TABLE IV.—PRODUCE OF WHEAT (ROTATION NO. 3), IN 1883, AFTER SEEDS FED ON THE LAND IN 1882.

Plots of One Acre.		Dressed Corn.						Straw, Chaff, &c.
		Head-Wheat.			Tail-Wheat.			
		Weight.	Bushels.	Weight per Bushel.	Weight.	Bushels.	Weight per Bushel.	
		cwts. qrs. lbs.		lbs.	cwts. qrs. lbs.		lbs.	tons. cwts. qrs. lbs.
1	Seeds fed off by sheep, which consumed 672 lbs. of decorticated cotton-cake ..	21 1 0	39·6	60·0	3 0 8	6·5	52·4	2 5 1 6½
2	Seeds fed off by sheep, which consumed 728 lbs. of maize-meal	21 2 0¼	39·8	60·5	3 0 2½	6·4	52·3	2 7 1 17½
3	Seeds fed off by sheep without cake or corn, top-dressed in spring with artificial manures, containing as much nitrogen, potash, phosphoric acid, &c., as 672 lbs. of decorticated cotton-cake	18 1 27	34·8	59·4	4 2 6¾	9·8	51·8	2 15 3 13½
4	Fed off by sheep without cake or corn, top-dressed in spring with artificial manures, containing as much fertilising matter as the dung from 728 lbs. of maize-meal ..	21 2 26	40·9	59·5	2 2 4	5·5	51·8	2 13 3 8½

PLOT 2.—With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. of maize-meal.

PLOT 3.—With dung, made from 1350 lbs. straw as litter; 5000 lbs, mangolds; 1250 lbs. wheat-straw chaff; and artificial manure. containing two-thirds as much nitrogen, and the other constituents, of the manure from 1000 lbs. decorticated cotton-cake; namely, 248 lbs. nitrate of soda, 100 lbs. of bone-ash (made into superphosphate), 62½ lbs. sulphate of potash, and 65 lbs. sulphate of magnesia.

PLOT 4.—With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff; and artificial manure, containing as much nitrogen, and other constituents, as the manure from 1000 lbs. maize-meal; namely, 80 lbs. nitrate of soda, 16¼ lbs. bone-ash (made into superphosphate), 7 lbs. sulphate of potash, and 11 lbs. sulphate of magnesia.

For the succeeding barley in 1883 no artificial manure was used on plots 1, 2, and 4; and on plot 3 only the remaining one-third of the equivalent of nitrogen in the manure from 1000 lbs. of decorticated cotton-cake, the other two-thirds having been already applied to the swede crop.

The barley, though coming up well in May and June, suffered severely from the heavy rains and storms of July, even more so than the wheat crops. It was much beaten down and storm-twisted, plot 3 especially showing this very markedly —this continued throughout July. On my visit of August 3rd, I found that no great difference was noticeable in any of the plots, and that on all of them the barley had gone down more or less. The barley was cut on August 21st and following days, and carted and stacked on September 4th, 6th, and 7th, all being got in in good condition. It was threshed in the field on October 24th and 25th; and the corn, after a short storing in the granary, was winnowed, measured, and weighed on October 31st, the results being given in Table V. (p. 356).

In every case the yield of corn was more than that of 1882, plot 1 showing this the least, while the other three gave a very large increase, amounting in the case of plots 3 and 4 to one-third of the total yield of 1882. There was but little difference in the amount of straw. The largest crop was obtained from the maize-meal plot, while the decorticated cotton plot, which had in 1882 given the best results, was now the poorest of all four. In fact, the decorticated cotton-cake plot now gave even a poorer yield than the unmanured plot 4, which had been fed off by sheep, receiving no purchased additional food—thus reversing exactly the results of last year as regards the two plots 1 and 2. The ill effects noticed last year on plot 3, by the top-dressing of nitrate of soda, were not repeated in this year's experience.

TABLE V.—PRODUCE OF BARLEY (ROTATION NO. 4), IN 1883, AFTER SWEDES FED ON THE LAND.

Plots of One Acre.		Dressed Corn.						Straw, Chaff, &c.
		Head-Corn.			Tail-Corn.			
		Weight.	Bushels.	Weight per Bushel.	Weight.	Bushels.	Weight per Bushel.	
		cwts. qrs. lbs.		lbs.	cwts. qrs. lbs.		lbs.	tons. cwts. qrs. lbs.
1	Without artificials (cotton-cake plot) ..	24 3 9	50·8	54·7	1 2 2½	3·6	46·5	1 14 0 12½
2	Without artificials (maize plot)	28 1 16	58·0	54·8	0 3 8¾	2·0	46·3	1 15 1 13
3	With artificial manure, containing one-third as much nitrogen as the manure from 1000 lbs. decorticated cotton-cake, namely, 124 lbs. nitrate of soda	27 1 22	57·0	53·9	1 1 8½	3·5	41·8	2 1 2 1
4	Without artificial manure	25 2 14	52·8	54·3	2 0 13	5·0	47·4	2 2 1 4

Experiments on Oats in Warren Field.

These experiments were instituted in 1880 to try the effects of soluble and finely-ground phosphatic fertilisers. The following course has been observed:—1880, swedes; 1881, barley; 1882, seeds; 1883, oats.

Oats, 1883.—The clover-crop of 1882 having failed, the ground was ploughed up for the first time on September 19th; it was found very hard to get the twitch out, as it had in places gone down as much as 18 inches. It was dug out by following after the plough. The field was partly scuffled on September 28th, and during the heavy wet weather of October the draining was very effective. On March 10th it was scuffled, and on April 10th oats were sown at the rate of eight pecks per acre.

Hoeing was begun on May 8th, harrowing on the 10th, and horse-hoeing on the 25th. At this time the oats were growing strongly and evenly. In June there were already great differences to be observed in the several plots; the most striking was plot 11, to which chalk had been applied, then plot 8 (20 tons dung), and after them plot 3 (Redonda phosphate). At my visit on August 3rd the chalk plot continued to look the best. The oats were cut on August 14th, carted and stacked on August 23rd and 24th, all in splendid condition. The crop was threshed, weighed, and measured on Nov. 22nd and 23rd, the produce of corn and straw being given in Table VI. (p. 358).

The experiments were made in duplicate.

In these experiments it was noticed once more that, just as with the previous swede crop in 1880, and barley crop in 1881, the soil of plots 1A and 7B was less productive than the rest of the field. The best results were obtained with Redonda phosphate, though the previous barley crop was nearly the smallest. As had been concluded from observation earlier in the season, the chalk plots (plots 11A and 11B) turned out extremely well, and the average of the straw-yield was higher on these than on any of the plots. The beneficial effect of chalk appears to indicate that the soil, which is naturally deficient in lime, needed an addition of lime to make it produce a good oat-crop.

Altogether the difference between the several plots when the produce came to be weighed was found not to be much, and the results of plots 1 and 7 were rendered useless as a base of comparison, on account of the great differences between the duplicate portions of each, for the reasons given before. In every case of the manured plots the mean results came above that recorded for the unmanured, as had been observed already in the swede crop of 1880.

TABLE VI.—PRODUCE of OATS in WARREN FIELD in 1883, after SWEDES in 1880, and SEEDS in 1882.

Results calculated per Acre.

PLOTS ¼ Acre each.	Manures per Acre used for Swedes in 1880.	Weight of Oats.				Number of Bushels.	Weight per Bushel.	Straw.			
		Tons.	cwts.	qrs.	lbs.		lbs.	Tons.	cwts.	qrs.	lbs.
1 A.	Ground coprolites, 6½ cwts.	0	19	3	27	62·2	36·1	1	8	0	4
1 B.		1	3	0	6	67·2	38·4	1	18	3	22
Mean		1	1	2	2½	64·7	37·25	1	13	1	27
2 A.	Dissolved coprolites, 5 cwts. ..	1	4	0	2	72·1	37·3	2	0	0	2
2 B.		1	5	1	27	72·8	39·2	1	18	2	24
Mean		1	4	3	0½	72·4	38·2	1	19	1	13
3 A.	Ground Redonda phosphate, 10 cwts.	1	3	3	1	70·6	37·7	1	18	3	16
3 B.		1	9	1	13	86·9	38·5	2	1	0	18
Mean		1	6	2	7	78·7	38·1	2	0	0	3
4 A.	Dissolved bone-meal, 3½ cwts.	1	1	2	5	63·6	37·9	1	15	3	16
4 B.		1	0	0	7	59·0	37·9	2	0	2	10
Mean		1	0	3	6	61·3	37·9	1	18	0	27
5 A.	Precipitated phosphate, 4½ cwts.	1	1	0	8	68·6	38·3	1	16	3	4
5 B.		1	4	2	12	70·6	39·0	1	19	1	20
Mean		1	2	3	10	66·1	38·6	1	18	0	12
6 A.	No manure ..	1	0	1	22	59·0	38·8	1	15	3	24
6 B.		0	19	3	9	61·2	36·3	1	15	3	0
Mean		1	0	0	14½	60·1	37·5	1	15	3	12
7 A.	Raw bone-meal, 3 cwts.	1	2	2	23	66·0	38·5	1	14	1	8
7 B.		0	17	3	20	56·4	35·6	1	12	0	16
Mean		1	0	1	7½	61·2	37·0	1	13	0	26
8 A.	20 tons of dung	1	4	3	14	70·0	39·8	2	3	2	10
8 B.		1	4	0	17	70·8	38·2	2	0	2	10
Mean		1	4	2	1½	70·4	39·0	2	2	0	10
9 A.	10 tons of dung, and 5 cwts. dissolved coprolites	1	4	0	1	68·6	39·2	2	1	3	16
9 B.		1	1	3	0	65·1	37·4	1	18	2	6
Mean		1	2	3	14½	66·8	38·3	2	0	0	25
10 A.	10 tons of dung, and 6½ cwt. of raw coprolites	1	2	0	13	63·2	39·2	2	3	0	16
10 B.		1	1	1	4	62·0	38·4	1	17	2	8
Mean		1	1	2	22½	62·7	38·8	2	0	1	12
11 A.	5 tons of chalk	1	4	0	18	69·0	39·2	2	6	0	12
11 B.		1	5	2	7	74·9	38·2	2	1	0	22
Mean		1	4	3	12½	71·9	38·7	2	3	2	17
12 A.	3 cwts. of dissolved coprolites and 2½ cwts. of Peruvian guano ..	0	19	3	16	58·8	37·9	2	3	0	2
12 B.		1	4	2	0	70·7	38·8	1	16	1	10
Mean		1	2	0	22	64·7	38·3	1	19	2	20

* The Plots No 1A and No. 7B are at the end of the field, where the soil from some cause or other is clearly less productive than the remainder of the field. This was also proved to be the case by the results of the previous swede and barley crops.

Experiments on Peas in Lansome Field.

These experiments were with soluble and finely-ground phosphatic fertilisers, and were similar in character to those on the heavier land of Warren Field. They were commenced in 1881 on the light land of Lansome Field. In that year swedes were grown; barley followed in 1882, and peas were grown in 1883.

Table VII.—Produce of Peas in Lansome Field in 1883, after Swedes fed off with Cake and Corn in 1881, and Barley in 1882.

Results calculated per Acre.

Plots ¼ Acre each.	Manures per Acre used for Swedes in 1881.	Weight of Peas.			Number of Bushels.	Weight per Bushel.	Straw.			
		Cwts.	qrs.	lbs.		lbs.	Tons.	cwts.	qrs.	lbs.
1 A.	No manure ..	19	3	12	35·4	62·75	1	18	2	10
1 B.		23	3	6	42·8	62·25	2	7	1	20
Mean		21	3	9	39·1	62·5	2	3	0	1
2 A.	5 cwt. ground coprolites, cost 1*l.* per acre ..	22	3	20	40·5	63·25	2	6	1	0
2 B.		23	3	4	43·1	61·8	2	5	2	12
Mean		23	1	12	41·8	62·5	2	5	3	20
3 A.	5 cwt. dissolved coprolites, cost 1*l.* per acre ..	23	0	20	41·2	63·0	3	0	1	24
3 B.		26	2	24	47·8	62·6	2	18	3	14
Mean		24	3	22	44·5	62·8	2	19	2	19
4 A.	5 cwt. Redonda phosphate, cost 17*s.* 6*d.* per acre	21	3	18	39·1	62·75	2	14	3	4
4 B.		26	0	24	47·5	61·8	2	7	1	18
Mean		24	0	7	43·3	62·2	2	11	0	11
5 A.	4 cwt. precipitated phosphate, cost 1*l.* per acre ..	19	3	8	35·4	62·75	2	9	3	22
5 B.		25	1	20	45·6	62·5	2	8	1	24
Mean		22	2	14	40·5	62·6	2	9	0	23
6 A.	3 cwt. bone-meal, cost 22*s.* 6*d.* per acre	24	1	16	43·3	63·1	2	2	1	2
6 B.		25	0	0	44·0	63·6	2	4	3	10
Mean		24	2	22	43·6	63·3	2	3	2	6
7 A.	3 cwt. dissolved bones, cost 19*s.* 6*d.* per acre	23	2	8	41·6	63·6	2	6	1	2
7 B.		24	3	4	43·8	63·3	2	14	0	24
Mean		24	0	20	42·7	63·4	2	10	0	29
8 A.	3 cwt. dissolved coprolites and 2½ cwt. of Peruvian guano, cost 43*s.* 3*d.* per acre	21	3	12	39·0	62·8	2	11	0	18
8 B.		25	3	12	46·8	61·8	2	7	0	16
Mean		23	3	12	42·9	62·3	2	9	0	17

The land was ploughed for the first time on September 4th and a second time on February 8th, after it had been twitched. On February 28th common maple peas were drilled in, at the rate of eight pecks per acre, and all went in well. The land was rolled on April 11th with a light roller, and horse-hoed, harrowed, and rolled on April 26th. At this time the peas looked well, but hogweed was very thick, though it was mostly killed by the

horse-hoe and harrows. On May 22nd the land was hand-hoed. The peas bloomed well in the middle of June, and looked very healthy; they were still blooming at the end of July. Visiting the plots on August 3rd, I could notice no difference between any of them. Cutting began on August 14th and continued till the 17th; then the peas were allowed to dry, and were carted and stacked on August 28th and 29th, a very heavy crop being realised. Threshing took place on December 13th and 14th, when the results set forth in Table VII. (p. 359), were obtained.

These experiments, like those in Warren Field, were carried on in duplicate.

In these trials the natural variations in the productive powers of the soil of the plots of section A and those of section B, as had been already noticed in the barley crop of 1882, vitiate the value of the experiments; thus, for example, the unmanured plot 1A yielded 35·4 bushels, weighing 19 cwts. 3 qrs. and 12 lbs., and the duplicate unmanured plot 1B gave 42·8 bushels, weighing 23 cwts. 3 qrs. 6 lbs., or 4 cwts. more per acre. Similar differences are observable in other duplicate plots, especially plots 4A, 4B, and 5A, 5B.

In face of these objections, I can only conclude that Lansome field is unsuitable for the purposes of experiment, on account of the natural variability of the soil of the different plots—a conclusion strengthened by the previous year's experiments with barley.

RAINFALL AT WOBURN DURING 1882 AND 1883.

	1882.		1883.	
FIRST HALF-YEAR—	inches.		inches.	
January	1·33		1·95	
February	1·50		2·98	
March	·98		·89	
April	3·41		1·55	
May	1·75		1·40	
June	2·10		2·89	
	——	11·07	——	11·66
SECOND HALF-YEAR—				
July	2·41		3·07	
August	1·64		·84	
September	2·58		3·81	
October	4·72		1·82	
November	3·39		2·37	
December	2·33		·63	
	——	17·07	——	12·54
		28·14		24·20

XII.—*Annual Report of the Consulting Chemist for* 1883. By Dr. Augustus Voelcker, F.R.S.

In presenting the usual Annual Report to the Chemical Committee I have the pleasure of reporting continued satisfactory progress in the Chemical Department of the work of the Society.

The number of analyses made for Members during the last year has been greater than in any previous one. The total number of samples received for analysis in the course of the year terminating the 1st of December, 1883, amounted to 1453, and exceeded those of the preceding year by fifty.

Of this large number of samples analysed in the Society's Laboratory, nearly 500 were oil-cakes and feeding-meals, as will be seen by the appended summary (p. 368), which gives a detailed enumeration of the materials which were sent for analysis.

Hard-pressed and Indigestible Linseed- and Decorticated Cotton-Cakes.—Several cases were brought under my notice in which the use of linseed-cake was suspected to have done injury to stock. A careful examination of the suspected cakes, however, showed that no ingredients prejudicial to health were present, nor that the cakes in question were mouldy or in a condition of incipient decomposition. The linseed-cakes complained of were, however, without exception, very hard pressed —some as hard as a board, and on analysis proved to be greatly deficient in oil. Owing to the improved machinery which of late years has been introduced pretty generally in the American and in not a few English oil-mills, linseed is much more thoroughly crushed and harder pressed than in former years, and is thereby deprived more efficiently of its oil. Of all the constituents of food, ready formed oil or fat unquestionably is the most valuable. Linseed-cake comparatively speaking poor in oil is consequently less valuable than cake richer in that substance. In round numbers 1 lb. of fat goes as far as 2½ lbs. of starch or sugar in fulfilling similar functions in the animal economy. Apart from the greater feeding and fattening value of linseed-cakes rich in oil, such cakes possess the further advantage of being softer and more readily broken up into small bits than hard-pressed cakes, which, as a rule, are deficient in oil; and when broken up as usual by a cake-breaker, the latter have proved in practice so indigestible as to endanger the health of stock, or to prevent their thriving as much as they will do when fed upon really good soft linseed-cakes rich in oil. In illustration of the fact that linseed-cakes, although made from perfectly pure and sound linseed, at the

present time frequently possess less value than before the introduction of improved crushing machinery in oil-mills, the following, selected from a large number of analyses referring to hard-pressed linseed-cakes, may be quoted :—

Composition of Hard Pressed Linseed-cakes.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Moisture	12·02	11·03	12·40	11·01	11·10
Oil	6·76	7·93	7·37	6·33	6·83
*Albuminoids	31·75	27·81	28·31	32·94	25·87
Mucilage, sugar, and digestible fibre	33·62	35·99	36·13	35·07	36·82
Indigestible woody fibre (cellulose)	10·37	7·16	9·39	8·90	10·73
†Mineral matters (ash)	5·48	10·08	6·40	5·75	8·65
	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen ..	5·08	4·45	4·53	5·27	4·14
† Including sand	·19	4·74	1·35	·15	3·65

It will be seen that the cake to which the analysis marked No. 4 applies, contained only $6\frac{3}{4}$ per cent. of oil, but that it was very rich in nitrogenous compounds (albuminoids), and, practically speaking, contained no sand. The analysis marked No. 5 refers to an adulterated linseed-cake, which, moreover, was made from dirty, that is to say, badly screened seed; but the No. 4 cake I found was made entirely from unusually clean linseed. Unfortunately it was very hard pressed, and poor in oil in consequence, and I have no doubt all the more indigestible because it was so rich in albuminoids.

The sender of this cake wrote to me on the 26th of November: "I would ask your attention to discover, if possible, anything to account for the death of two cows which have been feeding upon the cake."

On analysis I did not find a trace of any metallic or mineral poisons in it, nor did the microscope reveal any injurious or questionable weed-seeds; the cake, indeed, was made, as just stated, from unusually clean linseed and nothing else, but, unfortunately, it was as hard as a board. I think it very likely that it caused the death of the two cows, not because it contained any positively poisonous ingredients, but because it was poor in oil and rich in nitrogenous compounds, and was in a mechanical condition in which such cake, as usually given to stock, is unquestionably most indigestible.

If cakes of this kind are given to stock, they should be broken up much finer than usual, or, better still, ground into a regular meal.

For comparison with the preceding analyses, I append the following three; one representing the composition of a pure linseed-cake of average quality, somewhat poor in oil, the second showing the composition of superior linseed-cake, and the third that of a pure linseed-cake of the best quality:—

COMPOSITION of THREE PURE LINSEED-CAKES.

	No. 1.	No. 2.	No. 3.
Moisture	13·25	12·44	12·06
Oil	10·33	12·16	13·76
*Albuminous compounds	32·06	29·56	29·31
Mucilage, sugar, and digestible fibre ..	30·80	31·18	29·96
Indigestible woody fibre (cellulose)	8·26	8·67	10·13
†Mineral matters (ash)	5·30	5·99	4·78
	100·00	100·00	100·00
* Containing nitrogen	5·13	4·73	4·69
† Including sand	·40	1·29	·64

Still more numerous than the complaints about the quality of linseed-cake have become of late the complaints respecting the bad quality of decorticated cotton-cake; and during the past year several cases were brought under my notice in which decorticated cotton-cake was alleged to have caused the death of fattening bullocks. In every instance in which decorticated cotton-cake was reported to me to have done injury to stock, I found the cake hard-pressed, poor in oil, unusually rich in albuminoids, and full of small bits or lumps, varying in size from that of a pea to a hazel-nut, of highly indigestible consolidated cotton-seed meal, which, owing to carelessness in the oil-mills, are pressed into the decorticated cotton-cake. Such cake, according to my experience, cannot be safely given to stock if it be merely broken up into coarse bits by a cake-breaker. It ought to be ground to meal, and mixed with Indian corn or barley-meal, or any meal rich in starch or other non-nitrogenous compounds, and comparatively poor in albuminoids.

In former years the percentage of oil in American decorticated cotton-cake was seldom less than 16, and not unfrequently rose to 18 and more.

At present the composition and, with it, the feeding and

fattening qualities of decorticated cotton-cake vary exceedingly, as will be seen from the following analyses, which I have taken at random from the analytical results of a large number of cotton-cakes which have passed through my hands during the last twelve months.

COMPOSITION of DECORTICATED COTTON-CAKES, of variable QUALITY.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Moisture	9·28	8·59	7·95	8·75	8·95
Oil	12·93	22·10	16·57	15·70	10·23
*Albuminoids	46·37	42·87	42·37	49·02	49·04
Mucilage, sugar, and digestible fibre	21·92	17·29	22·86	17·52	22·92
Indigestible woody fibre (cellulose	3·47	3·31	3·10	3·51	3·21
Mineral matter (ash)	6·03	5·84	7·15	5·50	5·65
	100·00	100·00	100·00	100·00	100·00
* Containing nitrogen ..	7·42	6·86	6·78	7·85	7·04

COMPOSITION of TEXAS DECORTICATED COTTON-CAKE.

	No. 6.	No. 7.	No. 8.	No. 9.
Moisture	10·15	10·08	11·45	10·95
Oil	15·26	11·66	10·60	8·76
*Albuminoids	38·37	40·69	38·62	40·87
Mucilage, sugar, and digestible fibre	19·84	24·65	25·57	23·29
Indigestible woody fibre (cellulose	10·83	7·03	8·26	10·83
Mineral matters (ash)	5·55	5·89	5·50	5·30
	100·00	100·00	100·00	100·00
* Containing nitrogen ..	6·14	6·51	6·22	6·54

The preceding analyses show that the proportions of oil in decorticated cotton-cake vary from 8¾ to 22 per cent, and the percentage of albuminoids from 38 to 49 per cent.—in round numbers.

A food containing nearly as much as half its weight of nitrogenous constituents and only 10 per cent. of oil, pressed into a hard cake, is not suitable for herbivorous animals. Such

food requires to be ground into meal, and largely diluted with starchy or similar meals that are comparatively poor in nitrogenous compounds, in order to be wholesome and safe food for ruminants.

It will likewise be seen that all the Texas cakes contained more indigestible woody fibre than the cakes the analyses of which are given on p. 364 under the columns No. 1 to No. 5.

Most of the Texas cakes were not only hard pressed, but they also contained much cotton-wool; several were mouldy, and also in my judgment totally unfit for feeding purposes.

Loker-Meal.—Under this name a sample of meal was sent for analysis, which gave the following results;—

Moisture	13·55
Oil	·90
*Albuminous compounds	8·69
Mucilage, sugar, digestible fibre, &c.	69·68
Indigestible fibre (cellulose)	5·17
Mineral matter (ash)	2·01
	100·00
* Containing nitrogen	1·39

This meal was sold at the rate of 20*s.* per cwt. On examination I found that it consisted chiefly, if not entirely, of the ground hard seeds of locust-bean pods. I take it that the name "loker-meal" is a corruption for locust-meal. The price at which this meal was sold is about four times as high as corresponds to its real feeding value.

Buying Manures on the strength of Guaranteed Analyses.—It cannot be too strongly impressed upon agriculturists how great a risk they run of being supplied with inferior manures at extravagant prices if they neglect to buy manures, such as dissolved bones, guano, turnip-manure, &c., without a definite analytical guarantee. The Quarterly Reports of the Chemical Committee prove this abundantly. Nevertheless, it is surprising still to find so many farmers disregard altogether the recommendations as regards analytical guarantees which the Chemical Committee issued some years ago. It is well for intending purchasers of artificial manures to bear in mind that in statements of analytical guarantees, the lower figures alone are binding. Thus, a manufacturer or dealer guaranteeing in a manure 5 to 7 per cent. of ammonia, and 10 to 15 per cent. of soluble phosphate, binds himself to supply not less than 5 per cent. of ammonia, and 10 per cent. of soluble phosphate. This being the case, analytical statements in which the difference of the value of the manure between the lower and higher figures

sometimes exceeds 30*s.* per ton, are misleading, and ought to be abandoned by manufacturers and dealers in artificial manures.

When manures such as superphosphate have been bought of a definite guaranteed strength, there is no difficulty in adjusting the price, if on delivery of the bulk the manure does not come up to the guarantee.

Mineral superphosphate at present may be bought at 3*s.* per cwt. of soluble phosphate; consequently superphosphate guaranteed to contain 26 per cent. of soluble is worth 3*s.* × 26 = 3*l.* 18*s.* per ton.

In two cases in which mineral superphosphate of that guaranteed strength was bought at 3*l.* 18*s.* per ton. the bulk on delivery in one case was found to contain 18·45 per cent., and in the second only 12·59 per cent. of soluble phosphate, instead of 26. In the first case the buyer claimed and obtained compensation for the deficiency of 7½ per cent. of soluble phosphate, namely, 3*s.* × 7½, *i.e.* 22*s.* 6*d.* per ton; and in the second case, instead of having to pay 3*l.* 18*s.* per ton, the purchaser paid only 3*s.* × 12½ = 1*l.* 17*s.* 6*d.* per ton.

Peat-Moss Litter Manure.—In my last Annual Report I directed attention to the use of peat-moss as a substitute for straw in stables and cow-sheds.

The following analyses show the composition of farmyard-manure, which was made entirely with the employment of peat-moss as litter;—

Moisture	66·01	62·70
*Organic matter and salts of ammonia	27·16	30·38
Phosphate of lime	1·07	1·01
Alkaline salts, &c.	2·14	2·07
Insoluble siliceous matter	3·62	3·84
	100·00	100·00
* Containing nitrogen	·59	·66
Equal to ammonia	·73	·80

Both samples were rather superior in quality to good rotten ordinary dung.

Soils Deficient in Potash.—As a rule, kainit and potash salts do not produce any very marked effect when applied to clay soils, and generally are more beneficially applied to poor sandy soils or light land than to heavy land. There are, however, exceptions to this general rule; and only a few weeks ago, I made an analysis of a strong soil from East Kent, in which there were mere traces of available potash, as the following analysis shows:—

Composition of a Hop-soil (East Kent) almost destitute of available Potash.

	Dried at 212° F.
*Organic matter and water of combination	4·07
Oxide of iron	2·72
Alumina	2·47
Carbonate of lime	4·32
Magnesia	·53
Phosphoric acid	·26
Potash and soda (chiefly soda and mere traces of potash)	·38
Sulphuric acid	traces
Insoluble silicates and sand	85·25
	100·00
*Containing nitrogen	·18
Equal to ammonia	·21

The gentleman who sent me this soil for analysis wrote to me:—

"The soil of one of my hop-grounds used to be free from mould, but the last four or five years has been more or less liable to both white and red mould; and although replanted three years ago, the young hops this season (1883) were as bad as the old ones. There is no doubt a deficiency of some agent or other in the soil, and I shall be glad to know what it is, in order that I may remedy it, if possible, before the next season."

The soil had been heavily limed and manured with a good dose of dung, and about two tons of wool-refuse or shoddy per acre.

The preceding analysis shows that it contained abundance of lime, more than an average proportion of phosphoric acid, and a good supply of nitrogenous food, but that it scarcely contained any potash.

I do not remember ever having met a strong soil containing so little potash as this soil from a hop-garden in East Kent; and I have no doubt my recommendation to apply a good dose of potash-salts, mixed with some mineral superphosphate as a winter-dressing, will be found beneficial.

Fungus blocking up a drain.—Last April Sir John Swinburne, Capheaton, Newcastle, sent me for examination a peculiar-looking tough vegetable substance, which completely choked up some of his drains, accompanied by the following letter, addressed to Mr. Jenkins:—

"April 17th, 1883.

"Dear Sir,—A new plague has shown itself on my estate. Within the last six months we have found drains in a very stiff clay soil, with a rapid fall, choked with a substance of which I send you samples in two jars.

"The contents of one jar were taken from a 3-inch pipe, 5 feet below the

surface; the contents of the other are from a 4-inch pipe, 3 feet 6 inches below the surface.

"There is a strong run of water in the drains, which were put in eighteen years ago, and which showed no signs of failing until a few weeks ago, when the water rose to the surface, and on opening the drains they were found completely choked with this substance.

"Will you be good enough to have the contents of these jars submitted to Dr. Voelcker and the experts who advise the Society on botanical matters, and let me know whether the substance is made up of root-fibres of plants growing on the surface; or whether it is a subterranean growth generated in the same manner as the fungoid growth which is sometimes found under the bottoms of magazines in ships; and in dark cellars where there is no ventilation.

"Yours faithfully,

"JOHN SWINBURNE.

"The Secretary of the Royal Agricultural Society."

The substance which choked up the drains had nothing in common with the fibrous roots of trees and bushes, which sometimes find their way into draining pipes and choke them up. It had a peculiar smell, which in the course of a few days became most offensive. In its natural state it was elastic like india-rubber, and presented itself to even a superficial observer as of fungoid growth. Dried between blotting-paper as much as possible, this peculiar substance still retained a large proportion of water, as the following partial analysis will show:—

Water	83·37
*Organic matter	7·64
Mineral matter (ash)	8·99
	100·00
* Containing nitrogen	·52
Equal to ammonia	·63

The dried substance (dried at 212° F.), according to this analysis, contains 6·81 per cent. of nitrogen.

I submitted the plant to Mr. Carruthers, who wrote to me:—

"The plant you sent me has no fructification, nor was it likely to have any in the locality where it was found.

"It is, I have no doubt, a species of *Achlya*, a genus of plants which should be placed among the algæ, but they have no green colouring matter in them; and so they are sometimes referred to fungi, and sometimes to algæ."

This fungoid growth resembled in appearance the sewer fungus which may be seen in the carriers in which town-sewage is conveyed to the fields.

The 'Journal' of the Society for 1883 contains the following contributions of mine:—

1. Annual Report for 1882.
2. Quarterly Reports to Chemical Committee.

3. Report on the Field and Feeding Experiments, conducted at Woburn during the year 1882.
4. Reports on Lincolnshire Soils.
5. Report of Feeding Experiments on Sheep, conducted at Crawley-Mill Farm, Woburn, with Linseed-cake and Barley-meal, Linseed-cake and Malt, Linseed-cake and Pea-meal.

Analyses made for Members of the Royal Agricultural Society of England from 1st *December*, 1882, *to* 30*th November*, 1883.

Feeding-cakes	465
Feeding-meals	33
Corn, hay, and vegetable products	27
Cattle spices	3
Superphosphates, dissolved bones, and compound manures	381
Guanos	69
Bones, bone-meal, &c.	101
Refuse manures	16
Manure-cakes	6
Sewage-manures	12
Fish-manures	7
Dried blood	5
Horns and hoofs	7
Wool-dust and shoddy	36
Nitrates of soda and potash	60
Kainit and potash salts	31
Sulphate of ammonia	17
Soot	4
Lime, chalk, shell-sand, and minerals	9
Soils	61
Waters	73
Milk, cheese, butter, &c.	6
Articles of drink	3
Examinations for poison	7
Miscellaneous	14
Total	1453

The question of Ensilage has occupied my attention during the last three or four months, and a number of analyses have been made at the Laboratory, which I trust will throw light on the changes which green food undergoes in the Silo.*

In the course of the year I paid twelve visits to the Experimental Fields at Crawley-Mill Farm. The wheat-crop in the Rotation Experiments at Woburn yielded about 5 quarters of head-corn, weighing 60 lbs. per bushel, and $6\frac{1}{2}$ bushels of tail-wheat, weighing 52 lbs. per bushel, and from $2\frac{1}{4}$ to $2\frac{3}{4}$ of clean and strong straw.

The Rotation-barley was a good crop, yielding 51 to 58 bushels

* Owing to Dr. Voelcker's indisposition he has been unable to contribute his proposed paper on the Chemistry of Ensilage to this number of the 'Journal.'—EDIT.

of head-corn, weighing 54 lbs. per bushel, and 2 to 5 bushels of tail-barley, weighing from 41 to 47 lbs. per bushel, and about $1\frac{3}{4}$ tons to 2 tons of straw.

The oats in Warren-field yielded from 60 to 78 bushels on the several plots, weighing 36 to 39 lbs. per bushel, and $1\frac{1}{2}$ tons to 2 tons 6 cwts. of straw per acre.

The rotation roots produced from 20 to 23 tons of clean topped and tailed swedes per acre, and $2\frac{1}{2}$ to 3 tons of tops.*

XIII.—*Quarterly Reports of the Chemical Committee*, 1883.

March, 1883.

Dr. Voelcker reported the following cases:—

1. Mr. Obed Hosegood, Jun., Dillington Farm, Ilminster, requested me to analyse a sample of rape-cake which he had bought at 4*l.* 10*s.*, and which he suspected to contain something very poisonous, for on giving about 15 lbs. of the rape-cake to thirteen good large yearling bullocks at 7·30 in the morning, the herdsman noticed they did not eat any hay or roots after having eaten the cake, and at one o'clock most of them were lying down, and appeared in great pain. Before night three of them died, the rest got over the attack. The bullocks were perfectly well in the morning before eating the rape-cake.

The following is the analysis and report on this case:—

Moisture	11·39
Oil	7·13
*Albuminous compounds (flesh-forming matters)	30·87
Mucilage, sugar, and digestible fibre	28·94
Woody fibre (cellulose)	11·66
†Mineral matter (ash)	10·01
	100·00
* Containing nitrogen	4·94
† Including sand	4·55

Dear Sir,—The sample which you sent me contains a good deal of wild mustard, and in my judgment is a manure rape-cake and not a feeding rape-cake. Such a cake should not be used for feeding purposes, for there can be no doubt that it will act as an irritant poison when eaten by stock in considerable quantities.—Yours faithfully, Augustus Voelcker.

In reply to further inquiries Mr. Hosegood wrote on the 13th of January, 1883:—

I received the analysis of rape-cake safely, but do not wish it referred to any more, as the maker is, I think, a straightforward man, and he says he bought the seed and was not aware there was so much wild mustard-seed with it, and has paid damages when he saw your analysis.

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* For details of the Experiments at Woburn during the past year, see Dr. Voelcker's Report, commencing on p. 337.—Edit.

This case illustrates the risk which is run by purchasers of low-priced rape-cake without a guarantee that it is a good feeding-cake, and not simply a manure-cake.

2. A sample of linseed-cake, stamped "Pure" and sold at 8*l.* 5*s.* per ton, was sent for analysis on the 17th of January, 1883, by Mr. R. Richardson, West Rainton, Fence Houses, county of Durham.

This cake had the following composition:—

Moisture	12·66
Oil	7·27
*Albuminous compounds	23·19
Starch, mucilage, and digestible fibre	36·59
Indigestible woody fibre	10·97
†Mineral matter (ash)	9·32
	100·00
* Containing nitrogen	3·71
† Including silica	4·78

Although this cake was branded "Pure," it was adulterated with starchy mill-refuse, very poor in oil, and deficient in albuminous compounds.

Two tons were bought from Mr. Wm. Johnson, West Rainton, Fence Houses, county of Durham.

3. Mr. John Dalton, Sleningford Park, Ripon, sent me a sample of oil-cake on the 10th of last December, which on analysis gave the following results:—

Moisture	13·34
Oil	9·83
*Albuminous compounds	23·19
Mucilage, starch, and digestible fibre	35·09
Indigestible woody fibre	11·26
†Mineral matter (ash)	7·29
	100·00
* Containing nitrogen	3·71
† Including sand	2·84

The cake was made from badly screened linseed, and adulterated with starchy mill-refuse, and sold to Mr. Dalton as guaranteed pure. The contract was as follows:—

Sold to John Dalton, Esq., Sleningford Park, 40 tons, j.c., pure linseed-cakes, to be delivered at Tanfield Station in 5-ton lots as required from the present time until May 1st, 1883, the prices to be charged being 8*l.* 5*s.* per ton from now to September, and 8*l.* 15*s.* from September to May, 1883.

J. C. (for Carter and Son).

On the 15th of December last a cake very similar in composition and general character to the one mentioned above was sent to me by Mr. James Carter, Burton House, Bedale, as will be seen from the subjoined analysis:—

Moisture	13·40
Oil	9·73
*Albuminous compounds	24·19
Starch, mucilage, and digestible fibre	33·76
Indigestible woody fibre	10·87
†Mineral matter (ash)	8·05
	100·00
* Containing nitrogen	3·87
† Including sand	3·55

In reply to the usual inquiries, Mr. James Carter wrote as follows:—

Burton House, Bedale, December 26th, 1882.

Dear Sir,—I have received your analysis, for which I am much obliged. I am a partner in the firm of Carter and Son of Masham, the business being conducted by my sons. As, however, I use a good deal of the cake at my own place for feeding stock, I presume I am entitled to the privileges of the Society, as a private individual, so long as I do not make use of any analysis for trade purposes. In the present case it was simply a question as to whether Mr. Gothorp or myself should send you a sample for analysis, as we were both dissatisfied with the cake. If, however, I am exceeding my privilege by showing him the analysis, will you kindly acquaint me, and I shall have much pleasure in sending you a cheque for the additional charge. —Believe me, truly yours, James Carter.

Dr. Augustus Voelcker.

Since writing this, it has occurred to me that you can have no surety that your analysis may not be used for business purposes, therefore it would be unfair to claim any privilege as a consumer of cake, so that in future all analysis shall be sent by the firm.

On March 13th, Mr. Dalton forwarded for analysis a sample of cake purchased from the same vendors, which proved to be a good linseed-cake, made from fairly clean linseed, and nothing else.

4. A sample of manure sent on the 29th of January by Mr. A. C. Humphreys-Owen, Glansevern, Garthmyl, Montgomeryshire, was found to have the following composition:—

Moisture	4·95
*Organic matter and loss on heating	8·80
Phosphate of lime	9·65
Carbonate of lime	31·41
Sulphate and sulphite of lime	38·42
Oxide of iron, &c.	5·42
Insoluble siliceous matter	1·35
	100·00
* Containing nitrogen	·61
Equal to ammonia	·74

This manure, it will be seen, contained only about $9\frac{1}{2}$ per cent. of phosphate of lime, and $\frac{3}{4}$ per cent. of ammonia, and appears to me to be a mixture of about 80 per cent. of dried gas-lime or alkali waste, and 20 per cent. of bone-dust.

Mr. Humphreys-Owen informed me that this manure has been distributed widely in his neighbourhood, with a prospectus issued by the Grand National Agricultural Manure Company, established 1877, 101, Duke Street, Liverpool. In this prospectus the manure is described as prepared on a new and scientific principle, and possessing more lasting properties than any other artificial manure in the market. It will be found, the prospectus goes on to say, to contain, besides bones and valuable extracts, a condensed chemical composition, imparting to the whole those nourishing properties so beneficial to all crops, and so necessary for the renovation and sweetening of old pastures, &c. A number of testimonials in favour of the manure are printed in the prospectus. Orders are directed to be sent to J. Williams, 101, Duke Street, Liverpool.

It appears the manure is sold at *3l.* 10*s.* per ton, including bags, delivered carriage paid to any railway station, in quantities not less than two tons.

However, I should be sorry to have to pay 35*s.* a ton for a manure like the sample of the Grand National Agricultural Manure Company fertiliser, which Mr. Humphreys-Owen sent me for analysis.

Two samples of manure, similar in composition and general character to the preceding manure, were sent last February by Mr. F. Platt, Barnby Manor, Newark.

One of the manures was sold to Mr. F. Platt, under the name of Grand National Manure, at 4*l.* 10*s.* per ton, and the other as Special Grass Manure, at 6*l.* 10*s.* per ton, by Messrs. J. Williams and Co., manure manufacturers, guano and bone merchants, 101, Duke Street, Liverpool.

The following is a copy of the analyses and report which I sent to Mr. Platt:—

	No. 1. £4 10*s.*	No. 2. £6 10*s.*
Moisture	13·19	10·25
*Organic matter	5·16	7·01
Phosphate of lime	6·79	9·08
Carbonate of lime	31·64	27·16
Sulphates and sulphites of lime	34·38	38·16
Oxide of iron and alumina	7·89	7·33
Insoluble siliceous matter (sand)	·95	1·01
	100·00	100·00
* Containing nitrogen	·59	·68
Equal to ammonia	·59	·82

Dear Sir,—I beg to enclose analyses. The two manures consist mainly of dried gas-lime, or alkali waste, with some bone dust.

No. 1 contains about 14 per cent. of bone dust, and No. 2 about 20 per cent. I do not know on what principle 2*l.* more per ton is charged for No. 2 than for No. 1. I should hesitate to pay 35*s.* a ton for No. 2.

The two manures, it appears, were obtained through Mr. W. Beharrel, Fallowfield, Manchester.

Mr. F. Platt applied for a chemical analysis, which was refused on the ground that the manufacture of these manures was a secret, and that it was impossible for any analyst to detect it. The manures were highly recommended both for grass-land and arable, with directions to sow on low grass-land 5 to 6 cwt. per acre, and from 3 to 4 cwt. on higher or drier land.

December, 1883.

Dr. Voelcker reported the following cases:—

1. Mr. Horace Ledger, of Mortimers, Cliffe, Rochester, sent on June 8th, 1883, a sample of nitrate of soda, which he had purchased, on April 30th, from the "South London Manure Company," represented by a Mr. Edward Reeves, of 17, Lilford Road, Camberwell. The manure was invoiced at 12*l.* 10*s.* per ton. Dr. Voelcker reported on the sample as follows:—

Water	5·40
Chloride of sodium	48·01
Sulphate of magnesia	2·85
Insoluble matter	·25
Pure nitrate of soda	43·49
	100·00

June 15th, 1883.

Dear Sir,—The sample of nitrate of soda which you sent me on the 6th inst. is shamefully adulterated. Assuming good commercial nitrate of soda guaranteed 95 per cent. of pure nitrate, is sold at 12*l.* 10*s.* a ton, the sample you sent me would be worth 5*l.* 14*s.* 6*d.* a ton.

On receipt of this, Mr. Ledger wrote to "The Company" for 10 cwt. of nitrate of soda, with a written guarantee that it should contain not less than 95 per cent. of pure nitrate of soda. In reply he received the following:—

Memorandum.

June 22nd, 1883.

From
The South London Manure Company,
17, Lilford Road,
Camberwell, London.

To Mr. H. Ledger,
Mortimers,
Rochester.

Dear Sir,—We have this day ordered four bags N. of Soda forward to Cliffe Stn. to your order. Invoice of weight, &c., to follow. Soliciting your further favours, we are, dear Sir, yours faithfully,

The S.L.M. Company (per E. R.).

PS.—We are sending Mr. Pye some nitro-phosphate for turnips on Monday next. Should you require any we shall be pleased to send you some at the same time at 5*l.* 5*s.* per ton. We can recommend the above article as a first-class manure for all kinds of roots.

MEMORANDUM.

June 25th, 1883.

From
The South London Manure Company,
17, Lilford Road,
Camberwell, London.

To Mr. H. Ledger,
Mortimers,
Cliffe.

DEAR SIR,—Your letter to hand late Saturday night. The four bags N. of Soda forwarded to you we cannot guarantee analysis, as it is part of a lot we supplied to a party some two months since, who liquidated a week after we supplied it, and we succeeded in getting an order for its return to us. He had stored it at a public-house in the neighbourhood of Lewisham, where it has been ever since. We have no doubt of its being all right, and if you choose to keep it you can have it at 11*s.* 6*d.* per cwt., if not, we have a customer who will take it at another station, and we can forward you half a ton from our stores that has not been out of our possession since we drew it from the Docks, at 12*s.* 6*d.* per cwt., which we can guarantee. Please reply at once, so that we may order the four bags on to another station if you do not keep it. Have sent this by the 12.57 train, carriage paid. Please reply by this evening's post. (Unsigned.)

The vendors later in the day wrote again to Mr. Ledger, as follows :—

MEMORANDUM.

June 25th, 1883.

From
The South London Manure Company,
17, Lilford Road,
Camberwell, London.

To Mr. H. Ledger,
Mortimers,
Rochester.

DEAR SIR,—We wrote you this morning and forwarded letter per 12.57 train from London Bridge; was to (*sic*) late for 9.49 train. We explained reasons for not guaranteeing analysis of the four bags N. of Soda, as it has not been in our possession from the early part of April till within the last three weeks, when we with some difficulty and expense obtained an order to take the twenty-two bags stored by consignee at a public-house at Lewisham, and having a few bags left there when your order came to hand we forwarded some from the above. We have no reason to suspect it has been tampered with, and if you choose to keep it we will invoice it at 11*s.* 6*d.* per cwt., if not, we can transfer it elsewhere at the above price, and shall be pleased to forward you half a ton from our stores at 12*s.* 6*d.* per cwt., which has not been out of our possession since we carted it from St. Katharine's Docks, and can therefore guarantee it. If our letter per train does not reach you soon enough that we hear from you by first post to-morrow Tuesday morning shall run-down to-morrow morning by 9.49 train from L. Bridge.—Yours truly,

pp THE S.L.M. COMPANY,
E. R.

Mr. Ledger of course declined to accept these goods without the required guarantee.

2. A sample of nitro-phosphate manure sent on June 26th,

1883, by Mr. Henry Pye, of St. Mary's Hall, Rochester, yielded on analysis the following results :—

Moisture	12·08
*Organic matter and water of combination	26·06
Insoluble phosphates	·96
Sulphate of lime, alkaline salts, &c.	45·97
Oxide of iron and alumina	2·20
Insoluble siliceous matter	12·73
	100·00
* Containing nitrogen	1·09
Equal to ammonia	1·32

Mr. Pye stated that the sample was part of two tons of this manure, which he had purchased also of the "South London Manure Company," represented by Mr. E. Reeves, at 5*l*. 5*s*. per ton, and Dr. Voelcker reported to the purchaser as follows :—

The sample of so-called nitro-phosphate which you sent me for analysis you will see by the enclosed analysis contains no soluble and scarcely one per cent. of insoluble phosphate. It is a poor manure for roots and anything else, and I would not buy it if it were offered to me at 2*l*. a ton.

3. Messrs. W. and E. Marshall, of North Lynn, King's Lynn, sent on June 26th, 1883, a sample of a parcel of 20 tons of linseed-cake said to have been guaranteed "pure," and purchased at 7*l*. 12*s*. 6*d*. per ton. The following is the result of the analysis of the cake :—

Moisture	11·65
Oil	8·56
*Albuminous compounds (flesh-forming matters)	20·81
Mucilage, sugar, and digestible fibre	19·94
Woody fibre (cellulose)	20·24
†Mineral matter (ash)	18·80
	100·00
* Containing nitrogen	3·33
† Including silica and sand	9·55

Dr. Voelcker reported upon it as follows :—

The sample of cake which you sent me, and which I notice was branded "Pure," I find is poor in oil and in albuminous compounds. It is made from dirty linseed, and largely adulterated with ground rice husks or some similar material, consisting chiefly of woody fibre. The cake in my judgment is not worth 7*l*. 12*s*. 6*d*. a ton, and I would advise you not to use it, or, if you have used some of it, to place the remainder at the disposal of the vendor, to let him remove it from your premises at his own cost. Such cake ought not to be sold as pure, and as it is a very inferior adulterated cake I would refuse to take it at any price.

This cake was ordered and was delivered in May of last year, and it was purchased by a dealer as part of a small cargo which arrived by a sailing ship at Lynn from Hull. Mr. W. F. Marshall informed Dr. Voelcker afterwards that he had returned this cake.

4. Mr. T. Carrington Smith, of Admaston, Rugeley, forwarded to Dr. Voelcker a sample of Texas cotton-seed cake, with the following letter :—

Admaston, Rugeley, September 13th, 1883.

DEAR DR. VOELCKER,—I am sending you for analysis, &c., according to No. 12, a sample of "Texas cotton-seed cake." The following is a quotation from the seller's description: "This is the square-shaped cake, somewhat roughly made, but it is exceedingly rich in feeding properties." The last lot analysed :—

Oil	16·90
Flesh-forming matter	37·87
Ammonia	7·36

I have taken two tons on the condition that the quality is approximately near the above-quoted analysis.

I should like your opinion in addition as to how much per ton the cake is worth at present market value, and also whether it is safe as a food for all descriptions of cattle and sheep.—Believe me, yours faithfully,

T. CARRINGTON SMITH.

Dr. Augustus Voelcker.

The following is the analysis of the cake :—

Moisture	10·95
Oil	8·76
*Albuminous compounds	40·87
Mucilage	23·29
Woody fibre	10·83
Ash	5·30
	100·00
* Containing nitrogen	6·54

Dr. Voelcker reported as follows :—

September 21st, 1883.

DEAR SIR,—The sample which you sent me is a nasty stale cotton-cake which I do not consider a safe food for stock. It is poor in oil, and in my judgment ought to be used only for manuring purposes in place of manure rape-cake. I do not put a money value upon feeding stuffs.

A correspondence between Dr. Voelcker and Mr. Smith, as well as between the Secretary of the Society and Mr. Smith, ensued in consequence of the cake causing injury to a large number of stock and being suspected of containing some poisonous ingredients. The following are the most important letters on the subject :—

Admaston, Rugeley, September 25th, 1883.

DEAR MR. JENKINS,—On the 12th instant a lot of Texas cotton-cake came into my hands from dealers in Liverpool. Not liking the bulk, and considering the cake inferior to the description given of it by vendors, I sent, on the 13th, a sample to Dr. Voelcker for analysis under No. 12. Unfortunately I used some cake before I received Dr. Voelcker's report, which reached me only on the 23rd instant. On the 21st instant all my stock were apparently in fine health. On the 22nd every bullock in a lot of 13 was very ill, and three of these have died—the first at 3 P.M., the second at 8 P.M. on that day, and the third at 4 A.M. on the 23rd. Also, simultaneously, eight of my milking cows, fed and grazed in fields at a considerable distance

from the bullocks, were found ill on the morning of the 22nd. There have been no further deaths, and the eighteen animals under treatment are recovering. All attacked had been fed on Friday, the 21st, with 3½ lbs. each of the Texas cake. A duly qualified veterinary has had the animals under his charge from noon of the 22nd. In the opinion of this veterinary the cotton-cake is the cause of illness and death, and the cake itself contains an acrid poison. One of the animals dead was immediately dressed by a butcher, and the stomach, &c., opened and examined. The other two animals were skinned and buried where they died, and their stomachs and bowels were placed in bags for examination. I have asked the vendors of the cake to be present at an inquiry on the spot into the whole circumstances, but at present they refuse. I wish you to send down, as soon as possible, to-morrow (Wednesday), a veterinary professor competent for a thorough and exhaustive inquiry. The London and North-Western trains from Euston to Rugeley (three miles from me) are good, and I trust there will be time to-morrow for a complete examination on the spot, when also samples of the cake and contents of stomachs can be taken for analysis. I am writing by same post to the vendors of the cake, so that they can be represented on the inquiry if they think fit. Meanwhile everything is left, as far as possible, undisturbed. —Believe me, yours very faithfully,

H. M. Jenkins, Esq. T. CARRINGTON SMITH.

September 27th, 1883.

DEAR MR. SMITH,—Mr. Edward S. Shave, of the Royal Veterinary College, called upon me to-day, and placed into my hands two samples of Texas cake, which appear to me very much like the sample upon which I reported to you on the 21st inst. Presuming the cake to have done the mischief to your stock, as it in all probability did, there will be no use whatever in analysing the viscera of the animals, for in that case poison can be as little discovered in the stomach of an animal as in the case of mouldy stale bread or mouldy oats, or similar articles of food covered with fungi or mouldiness. As the cake is represented to be exceedingly rich in feeding properties, it may be advisable to have the two samples handed to me by Mr. Edward Shave analysed in conformity with the regulations of the Royal Agricultural Society. You will oblige me by sending me the requisite fee of 1*l.* for the analysis of the two cakes.—Yours faithfully,

AUGUSTUS VOELCKER.

Admaston, Rugeley, September 28th, 1883.

DEAR DR. VOELCKER,—The ground sample delivered to you by Mr. Shave will, I expect, give on analysis some distinctly poisonous ingredients. Perhaps I had better explain that, not suspecting anything deleterious in the cake when I sent you the sample on September 13th, I used it to many head of stock for more than a week, and no symptom of illness was shown in any one case until Saturday morning, the 22nd. On that morning 21 beasts were simultaneously attacked, the whole of one lot, viz., 13, 1⅔-year old bullocks, being dreadfully ill—three fatally—the other eight being milking cows out of a herd grazed in fields far away from the bullocks. These eight, though very ill at first, have all recovered, except that they have not come back to their full flow of milk. About 12 more milking cows were up to the 22nd inst. fed similarly with the Texas cake for the same period as those affected, and have not shown any symptoms of illness. *All* the 21 animals seized were on the day previous to their attack fed with 3½ lbs. of cake, the eight cows at 6 A.M. and the 13 bullocks at 10 A.M. I have come to the conclusion that, however mischievous the whole bulk is, there are in it some bags worse than others, and we cannot reasonably attribute the violent attack of the 21 animals to anything else than the presence of a very virulent poison in a particular bag out of which these 21 only were fed. We believe that

the ground sample is out of this bag. I need not say that under no circumstances should I have used a bit of the cake after receipt of your analysis, which came to hand on Sunday, the 23rd, just after the three bullocks had died. To this one particular feed on Friday, the 21st, I attribute my loss, as I can confidently state that on that day all were exceedingly blooming in appearance, and that in none of the remainder, similarly fed, has there been the slightest illness. Perhaps it seems a work of supererogation to analyse the unground sample given you by Mr. Shave, but under all the circumstances I have decided to have both the ground and unground samples analysed, and I would ask you in your analysis to look out specially for distinct poison as well as fungus or other impurity. Enclosed you will find cheque for 1*l.*—Believe me, yours very faithfully,

T. Carrington Smith.

Dr. Augustus Voelcker.

Dr. Voelcker's analysis of these two samples gave the following results :—

	I.	II.
Moisture	10·15	11·45
Oil	15·26	10·60
*Albuminous compounds	38·37	38·62
Mucilage, &c.	20·21	24·60
Woody fibre	10·46	9·23
Ash	5·55	5·50
	100·00	100·00
* Containing nitrogen	6·14	6·22

In sending the above analytical results, Dr. Voelcker wrote as follows :—

October 3rd, 1883.

Dear Mr. Smith,—I have made careful analyses of the two samples of Texas cotton-cake which Mr. Shave placed into my hands for examination, and have specially tested them, each sample for metallic and other mineral poisons, but cannot detect any poisonous matter in either of the two cakes, nor have I been able to detect with the microscope any poisonous seeds which might have been accidentally mixed up with the cake. The ground and the unground samples differ somewhat in composition, as you will see by the analyses. No. 2, that is the ground suspected cake, contains cotton-seed husks in a much coarser condition than the husks occur in No. 1 cake. I doubt not this has contributed to the injurious effects which the ground cake No. 2 produced. The cotton-seed husks in this cake are so coarse that I do not think the cake can be safely given to stock. You call No. 2 ground cake, but if you have given the cake in the same rough state as linseed, in pieces as large as the sample sent, I could have told you beforehand that you would not be able to feed your bullocks or cows for any length of time without their getting seriously ill.

The long and the short of the matter is that none of the three samples of Texas cake which you sent me, when broken up roughly like linseed cake, can be safely given to bullocks, cows, or sheep. The effect of the indigestible coarsely-ground husks and hard-pressed kernels in the shape of badly-broken cake, of inferior cotton-cake, like the three samples of cotton-cake you sent me, is to cause at first constipation of the lower bowels, and subsequently inflammation of the whole intestines and stomach, and violent purging. I need scarcely say that these ill-effects are not noticed for some time, especially if the bullocks are supplied with moderate quantities of cake. —Yours faithfully,

Augustus Voelcker.

5. Mr. James Chalcraft sent from East Worldham, near Alton, Hants, a sample of manure purchased as the best Peruvian guano at 13*l.* 10*s.* per ton.

Dr. Voelcker gave the following results of analysis, and his report upon it:—

Moisture	10·90
*Organic matter, &c.	35·72
Monobasic phosphate	9·87
Equal to tribasic phosphate of lime, rendered soluble	(15·45)
Insoluble phosphates	6·59
Sulphate of lime, &c.	25·32
Sand	11·60
	100·00
* Containing nitrogen	5·08
Equal to ammonia	6·17

Dear Sir,—The mixture which you sent me is not best Peruvian guano, but a regular artificial compound manure, for which I should be sorry to have to pay more than 10*l.* a ton. 13*l.* 10*s.*, in my judgment, is a most extravagant price for the manure which you sent me for analysis, and which ought not to be sold as best Peruvian guano.—Yours faithfully,

Augustus Voelcker.

No further information has been obtained from the purchaser.

XIV.—*Notes on the Composition of some Samples of Silage.* By Alfred Smetham, F.C.S., F.I.C., of Liverpool.

Composition of Grass pitted at Tatton Park, Knutsford, July 4, 1883.*

		In Sample dried at 212° F.
*Water	70·48	..
Fatty matters and chlorophyll (ether extract)	·83	2·80
*Soluble albuminous compounds	·90	3·06
Mucilage, sugar, and extractive matters	3·44	11·65
Digestible fibre	10·70	36·24
†Insoluble albuminous compounds	2·05	6·94
Indigestible woody fibre (cellulose)	9·54	32·33
Soluble mineral matters	1·54	5·24
Insoluble ditto ditto	52	1·74
	100·00	100·00
* Containing nitrogen	·14	·49
† Containing nitrogen	·33	1·11

* For description of the silo, and the method of ensilage adopted, see pp. 175 *et seq.*

The grass was taken from the portion first introduced into the silo, and, allowing for the decrease in volume, would be found converted into silage at about 1 foot 6 inches from the bottom.

COMPOSITION OF SILAGE MADE FROM ABOVE.

	Taken between 2 ft. & 1 ft. 6 in. from bottom.	Taken between 1 ft. 6 in. & 1 ft. from bottom.	Bottom layer.
Water and volatile matters	68·74	65·84	78·65
Fatty matters and chlorophyll (ether extract)	2·35	1·84	·92
*Soluble albuminous compounds	1·90	2·07	1·26
Mucilage, sugar, and extractive matters ..	1·78	2·94	·60
Digestible fibre	9·32	12·38	7·20
†Insoluble albuminous compounds	1·14	1·28	·82
Indigestible woody fibre (cellulose)	9·90	9·10	7·35
Soluble mineral matters	4·37	3·92	2·67
Insoluble ditto ditto	·50	·63	·53
	100·00	100·00	100·00
* Containing nitrogen	·30	·33	·20
† Containing nitrogen	·18	·20	·13
Acidity calculated as acetic acid ..	·31	·35	·50

	Taken between 2 ft. & 1 ft. 6 in. from bottom.	Taken between 1 ft. 6 in. & 1 ft. from bottom.	Bottom layer.
	In Sample dried at 212° F.	In Sample dried at 212° F.	In Sample dried at 212° F.
Water and volatile matters	..	..	..
Fatty matters and chlorophyll (ether extract)	7·52	5.39	4·31
*Soluble albuminous compounds	6·08	6·06	5·90
Mucilage, sugar, and extractive matters ..	5·69	8·61	2·81
Digestible fibre	29·81	36·24	33·72
†Insoluble albuminous compounds	3·65	3·75	3·84
Indigestible woody fibre (cellulose)	31·67	26·64	34·42
Soluble mineral matters	13 98	11·47	12·51
Insoluble ditto ditto	1·60	1·84	2·49
	100·00	100·00	100·00
* Containing nitrogen	·96	·97	·94
† Containing nitrogen	·58	·59	·61

The samples of silage taken from between 2 feet and 1 foot 6 inches and from between 1 foot 6 inches and 1 foot, were both in good condition; and, although distinctly acid, were not

unpleasant to the taste. In the sample No. 2 on the list, I determined the percentage of alcohol, and found it to be present to the amount of 0·34 per cent. This quantity was arrived at by distilling the extract from a large quantity of the silage after neutralizing the acid present by means of caustic potash. The distillate was distinctly alkaline, but not with ammonia, from which I infer that a small portion of the albuminoids during fermentation are split up into amines, which distilled over. The distillate, after being acidified. was again distilled, and the alcohol weighed in a delicate specific gravity-apparatus. I took care to verify the presence of alcohol in this distillate.

Only a part of the acid was present as acetic acid, part being present as butyric and part as lactic acid. It is also probable that other organic acids were formed, but these three are the chief. It is curious to note that as the silage approaches to the bottom, the percentage of acidity increases. The layer from the bottom was very wet, and too acid for cattle.

I also examined partially a sample of the liquid which had drained away from this lower portion.

It gave:—

Water and volatile matter at 212° F.	83·76
Non-volatile organic matters	13·15
Mineral matters	3·09
	100·00
The acidity calculated as acetic acid was ..	·89

In order to render the results of the analysis of the silage comparable with those obtained from the original grass, a deduction must be made for the salt added during the preparation. If this be done, and the nitrogen calculated into percentages, figures are obtained which may be compared with those furnished by the analysis of the dried grass. Thus it will be found that the percentages of total nitrogen in the dried grass and in the three samples of dried silage from which the salt has been deducted, are as follows:—

	In dried Grass.	In Sample taken 2 ft. & 1 ft. 6 in. from bottom.	In Sample taken 1 ft. 6 in. & 1 ft. from bottom.	Bottom.
Total nitrogen	1·60	1·68	1·66	1·67

These figures show, in each instance, a slight increase in the percentage of total nitrogen; and it may, therefore, be inferred that little or no loss of nitrogen has occurred during the process

of ensilage. The increased percentage is doubtless due to loss of sugar or other soluble carbo-hydrates through fermentation; which would leave the relative amount of nitrogenous matters in the dried silage higher than in the dried grass. But although there appears to have been no actual loss of nitrogen during the process, a very marked change has occurred in the constitution of the albuminous compounds. During the process of fermentation in the silo, nearly one-half of the insoluble albuminous compounds has been rendered soluble, and apparently split up into simpler substances.

A comparison made in this manner also shows that a considerable portion of the sugar and other soluble carbo-hydrates has been destroyed by fermentation, and converted into alcohol, carbonic acid, acetic, and other organic acids. The increase in the ether extract is partially due to the formation of organic acids soluble in ether, but non-volatile at 212° Fahr.—probably lactic acid.

The loss of water from the upper layers during ensilage has been appreciable. Unfortunately no attempt was made to register the temperature of the silo during the process; but it is evident, from the nature of the changes which have taken place, that considerable heat must have been generated, and this doubtless will have had its due effect in expelling a portion of the lost water, even from an apparently air-tight chamber. A portion also has drained away from the mass under the pressure to which it was subjected, and this possibly might be sufficient to account for the greater part of the loss. This liquid contained 83·76 per cent. of water and volatile matters, but a much smaller quantity of mineral matters than I should have predicted. The ash consisted chiefly of carbonate and phosphate of lime and potash, together with common salt, only a comparatively small amount being salt. Considering the large quantity of salt used in the manufacture, this fact is a little curious, and shows that the liquid has separated only at high pressure.

That the bulk of the silage taken from the silo at Tatton Park, and examined by me, is a valuable food cannot admit of a doubt; and it is equally clear that only a comparatively small part of the feeding value has been absolutely lost by the fermentative changes to which it has been subjected. It will be a matter for subsequent research to determine to what extent the feeding value is affected by the conversion of the insoluble albuminoids into a soluble condition; but it seems to me quite clear that, by the formation of amines, a small portion of the soluble nitrogen compounds must be looked upon as practically useless for feeding purposes.

The sample taken from the bottom of the silo was too wet, and contained too large a percentage of acid to render it a good food. The greater part of the soluble matters had been destroyed by fermentation resulting in the formation of acids. Any alcohol which may have been originally formed appears to have been oxydised into acetic acid, and I was unable to detect more than traces of alcohol in the liquid expressed from this lower portion.

Description of Mr. Smith's Silo at The Hollies, near Wilmslow, Cheshire.

Circular silo 12 feet diameter by 12 feet deep; it was filled with aftermath on October 20th, and well trodden down, and a weight of 100 lbs. per foot was put on for seven days; the weight was then taken off and the grass was found to have sunk 5 feet; it was then again filled to the top, and a weight of 200 lbs. per foot put on. It was opened on January 16th, and the contents found in good condition.

COMPOSITION OF SILAGE FROM MR. SMITH'S SILO.

		In Sample dried at 212° F.
Water and volatile matter	81·38	..
Fatty matters and chlorophyll (ether extract)	·74	3·98
*Soluble albuminous compounds	1·32	7·09
Mucilage, sugar, &c.	·22	1·18
Digestible fibre	6·82	36·63
†Insoluble albuminous compounds	1·14	6·12
Indigestible woody fibre	5·79	31·10
Soluble mineral matters	1·37	7·35
Insoluble ditto ditto	1·22	6·55
	100·00	100·00
* Containing nitrogen	·19	1·13
† ,, ,, ...	·21	·96
Acidity calculated as acetic acid	·18	..

The sample was not so good as that from Tatton Park.

No analysis was taken of the original grass in this case, and it is impossible, therefore, to determine to what extent loss by fermentation had proceeded. From the low percentage of soluble carbo-hydrates and the comparatively high percentage of nitrogen, it would appear that a perceptible loss had taken place: but without a knowledge of the composition of the original grass, it is impossible to arrive at any decision of scientific value.

No salt was used, and the grass was not cut up at all. No covering boards were put on between the grass and the bricks with which it was weighted.

Since January 16th nine head of cattle have been fed on it alone (except that they have been occasionally turned out for a few hours on very fine days). Mr. Smith states that he has never seen them in better condition than at present, and that they seem to be very fond of the silage. The silo was 7 feet below the ground and 5 feet above. No mould was found at the sides, and not more than 1 inch at the top. The total cost of the silo was 13*l.* 10*s.*, and the weight of its contents 14 tons.

Description of Mr. Earle's Silo at Hayton, near Liverpool.

"My Lascelles Portable Silo is 15 feet by 12 feet, and 10 feet deep. It is a simple wooden framework, five uprights on each side, and four at each end, all 4 in. by 4 in. let into timbers running along the top and bottom of the same side. The corners top and bottom are all braced with iron, bolted on, and an iron rod runs across the silo both top and bottom. On the inside of the wooden frame are screwed concrete slabs, 3 feet by 2 feet by $1\frac{1}{2}$ inches thick, four screws in each. The inside of the slabs is perfectly smooth. The silo stands on the stone floor of a large barn. After filling it, planks 2 in. thick and 5 in. wide were put on edge to edge, and weighted with $9\frac{3}{4}$ tons of ship's ballast.

"The crop was the best second-crop clover and rye-grass, chopped up by steam, and put in in the state in which it came from the field, which was generally wet. It was well trampled down, especially along the edges, and 29 tons filled the silo, eight half-days being occupied in doing so, and then the silo was finally closed. This was on September 17th. It was opened on January 4th. We found 4 in. of mould on the top and a little at the sides. No liquid had escaped from the bottom, and there was no drainage.

"I allow my six Devon milking cows 50 lbs. each per day, but find they cannot get through it, and do not eat more than 44 lbs. They have a little corn and bran given also, and we began giving a little long hay at night, but they will not touch it now, and tread it underfoot.

"They give a good quart apiece of milk more on silage than on hay and turnips, and the butter is more the colour of grass fed.

"I sent a sample of silage to the 'Field,' and the editor writes that 'it was in excellent condition and very pleasant in flavour;' and in this most of the farmers present at the opening agreed.

"The silo cost in London ready to put together ..	£16	0	0
Carriage to Hayton	5	0	0
Cost of planks to cover with	2	0	0
Cost of erecting	1	0	0
	£24	0	0

"The iron ballast cost 47*s.* per ton. The cost of chopping and putting the grass into the silo did not exceed 2*s.* 6*d.* per ton. Some of the clover was bought at the then market price of 23*s.* per ton.

"The grass sunk in the silo 2 feet 6 inches the first month, and nothing afterwards.

"What quantity we had in the silo on opening is a matter of conjecture—I should think close on 25 tons. A cubit foot weighs 46 lbs.

(Signed) "FREDERIC W. EARLE."

COMPOSITION OF SILAGE FROM MR. EARLE'S SILO.

		In Sample dried at 212° F.
Water and volatile matters	78·10	..
Fatty matter and chlorophyll (ether extract)	1·46	6·66
*Soluble albuminous compounds	1·14	5·20
Mucilage, sugar, and extractive matters	1·72	7·85
Digestible fibre	5'65	25·80
†Insoluble albuminous compounds	1·43	6·53
Indigestible woody fibre (cellulose)	8·05	36·76
Soluble mineral matters	1·35	6·17
Insoluble mineral matters	1·10	5·03
	100·00	100·00
* Containing nitrogen	·18	·82
† Containing nitrogen	·23	1·05
Acidity calculated as acetic acid	·33	..

An examination of the above figures shows that a smaller percentage of the albuminous compounds has been rendered soluble by the fermentative changes which have taken place at Hayton during the process of ensilage than at Tatton Park; and, as far as can be determined without an analysis of the original grass, it would appear that the composition of the silage approaches more nearly to that of the grass than any of the other samples which I have examined. Whether this has been brought about by the peculiar condition of the grass at the time of pitting, and by the shorter time occupied by the process of ensilage, or by the special form of the silo, it would be impossible to determine from the data in my possession. There can be no doubt, however, that the silage was in good condition, and was free from excess of acidity, when it was submitted to me for analysis. No determination was made of the percentage of alcohol present—if any.

The comparatively large percentage of water in the silage shows clearly that the process of ensilage may be conducted successfully even with wet substances, provided the requisite conditions be duly observed.

The sample was taken from the silo on March 25th, 1884, and the analysis commenced a few hours afterwards.

ADDITIONS TO THE LIBRARY IN 1883.

I.—PERIODICALS PRESENTED TO THE SOCIETY'S LIBRARY.

Presented by the respective Societies and Editors.

A.—English, American, and Colonial Periodicals.

Aberdeenshire Agricultural Association. Annual Report, Season 1882.
Agricultural Economist. Vol. XV. 1883.
——— Gazette. 1883.
——— Almanack. 1884.
Agricultural Returns of Great Britain. 1883.
——— Statistics, Ireland, 1883.
Agricultural Students' Gazette. 1883.
Athenæum. 1883.

Bath and West of England Society, Journal of the. 1883.
Bell's Weekly Messenger. 1883.
Bristol Mercury. 1883.

Clydesdale Stud Book. Vol. V. 1883.
Coates's Herd Book. Vol. XXIX. 1883.
County Gentleman. Vol. XXI. 1883.

Economist. Vol. XLI. 1883.
English Cart-horse Stud Book. Vol. IV. 1883.
Essex Standard. Vol. LIII. 1883.

Farm and Home. 1883.
Farmer. 1883.
Farmer's Herald. 1883.
Field. 1883.

Geological Society, Journal of the. Vol. XXXIX. 1883.

Highland and Agricultural Society of Scotland, Transactions of the. Vol. XV. 1883.

Illinois Railroad and Warehouse Commission. Report for 1882.
Illustrated Journal of Agriculture, Montreal. 1883.
Institution of Civil Engineers, Proceedings of the. 4 Vols. 1883.
——— of Mechanical Engineers, Proceedings of the. 1883.
——— of Surveyors, Transactions of the. Vol. XV. 1883.
Investor's Monthly Manual. 1883.
Irish Farmer. 1883.
—— Farmer's Gazette. 1883.
Ironmonger. 1883.

Journal of Forestry. Vol. VII. 1883.

Land. Vol. III. 1883.
—— Agents' Record. 1883.
Live-Stock Journal. 1883.
———— ——— Almanac. 1884.

Mark Lane Express and Agricultural Journal. 1883.
Massachusetts, Agriculture of, 1882.
Meteorological Record. 1883.
———— Society, Quarterly Journal of the. 1883.
Midland Counties' Herald. 1883.

Nature. 1883.
Newcastle Courant. 1883.
North British Agriculturist. 1883.

Prairie Farmer. 1883.

Red Polled Herd Book. Vol. II. Part II. 1883.
Royal Geographical Society, Proceedings of the. 1883.
Royal Institution of Great Britain. Vol. IX. 1881–2.
Royal Manchester, Liverpool, and North Lancashire Agricultural Society, Journal and Prize List. 1882.
Royal United Service Institution, Journal of the. 1883.

Society of Arts, Journal of the. 1883.
Statistical Society, Journal of the. 1883.
Sussex Association for the Improvement of Agriculture. Annual Report, Season 1882.

Trade and Navigation of the United Kingdom, Accounts relating to the, 1883.

Veterinarian, The. 1883.
Veterinary Journal. 1883.

B. List of Foreign Periodicals.

Berlin. Landwirthschaftliche Jahrbücher. Band XII. Hefte 1–6. Supplement, 1883.
——. Journal für Landwirthschaft. 1883. Hefte 1–4.
Bogotá. El Agricultor. Serie 4ª, Nos. 1–7. 1882.
——. ————. ———, Nos. 8–12. 1883.
Brussels. Journal de la Société centrale d'Agriculture de Belgique. 1883.
Buenos Aires. Anales de la Sociedad rural Argentina. Vol. XVII. 1883. Nos. 1, 7, 8, 10–15, 17–21.
Celle. Protokolle der Sitzungen des Central-Ausschusses der Königlichen Landwirthschaft Gesellschaft. 1883.
Crosne. Le Poussin. Nos. 35, 40–48. 1883.
Genève. Tableaux de Statistique Agricole du Canton de Genève. No. 1. 1883.
Hanover. Die dritte Concurrenz ganzer Landwirthschaftsberichte um Prämien in der Provinz Hannover und zwar im Bezirke des landwirthschaftlichen Haupt-Vereins Göttingen-Grubenhagen von Frühjahr 1881, bis Frühjahr 1882.
———. Jahresbericht der königlichen Landwirthschafts-Gesellschaft zu Celle: Central-Verein für die Provinz Hannover für 1882. 1883.
Kristiania. C. No. 15. Statistik Angaaende det Norske Jordbrug fornemmelig i Femaarsperioden 1871–1875 og i Aaret 1875.
Paris. Annales Agronomiques. Tome 9ᵐᵉ. Nos. 1–12. 1883.

Paris. Annales de l'Institut National Agronomique. 1883.
——. Journal d'Agriculture Pratique. 1883.
——. Journal de l'Agriculture. 1883.
——. Bulletin de la Société des Agriculteurs de France. 1883.
——. Ministère de l'Agriculture. Bulletin. 1883.
——. Rapport administratif sur l'Exposition universelle de 1878. 3 vols.
Rome. Annali di Agricoltura. 24 Parts. 1882–83.
——. Bollettino di Notizie Agrari. 1883.
——. Movimento commerciale dei principali prodotti Agrari, 1871–82. 1883.
——. Notizie intorno alle condizioni dell' agricoltura negli anni 1878–79. Vol. III. 1882.
Stockholm. Kongl. Landtbruks-Akademiens Handlingen och Tidskrift. Nos. 2–6. 1883.
Strasbourg. Bulletin Trimestriel de la Société des Sciences, &c., de la Basse-Alsace. Vol. XVII. 1883.

II.—BOOKS PRESENTED OR OTHERWISE ADDED TO THE SOCIETY'S LIBRARY.

Names of Donors in Italics.

A. English, American, and Colonial Books and Pamphlets.

Agricultural and Horticultural Association, Limited. Diagrams of Manures, Feeding Substances, Farm Crops, and Permanent Grasses.
Bull, Dr. Henry G. Herefordshire Pomona.
Bund, J. W. Willis. Agricultural Holdings Acts. Second Edition.
Chatterton, J. H. Compulsory Uniformity of Weight in the Sale of Corn.
Christy, Thomas. New Commercial Plants and Drugs. No. 7.
Department of Agriculture and Commerce, N. W. Provinces and Oudh. Field and Garden Crops. Part I.
Dickson, F. and A., and Sons. The Grasses of the Farm.
D'Oridant, Charles. Cattle Disease.
Euren, Henry F. Red Polled Cattle for the Stall and the Dairy.
Flax Supply Association. Sixth Annual Report, 1882.
Hallett, Major E. F. Food Plant Improvement.
Handbook of the Farm Series. Equipment of the Farm.
——————. Life on the Farm.
Indian Government. Collection of Papers on Bee-Keeping in India.
——————. Agricultural Implements and Machines which have been experimented with and found efficient and useful in India.
International Dairy Show Committee, Dublin, 1882. Lectures on "The Dairy and Dairy Farming;" "Bees and Bee-Keeping;" and "Poultry as a Source of Profit to the Farmers of Ireland."
Larkworthy, Falconer. New Zealand Re-Visited.
Lawes, Sir John Bennet. Determinations of Nitrogen in the Soils.
——————. Contribution to the Chemistry of Fairy Rings.
——————. Memoranda of the Origin, Plan, and Results of the Field and other Experiments at Rothamsted, June 1883.
Ormerod, Miss E. A. Guide to Methods of Insect Life.
——————. Lecture on Insect Prevention and Removal of Winter Shelters.

Ormerod, Miss E. A. Observations on First Appearances, &c., of Hop Aphis.
———————. Report of Observations of Injurious Insects. 1882.
Proctor, Frank. The Art of Mechanical Digging.
Robertson, Professor William. Equine Medicine.
Silos for British Fodder Crops.
Smithfield Club. History of the Smithfield Club. Third Edition.
Smithsonian Institution. Miscellaneous Collection. Vols. XXII.–XXVII.
———————. Report for 1881.
United States Department of Agriculture. Report for 1881–82.
———————. Special Reports, Nos. 55, 56, 57, 58, 59, 60, 61, 64, 65. New Series, 1, 2, 3.
Waring, George E. Concerning Mr. Rudulph Hering's Project for the Sewerage of Binghampton, N.Y.
Warington, R. On some of the Changes which Nitrogenous Matter undergoes within the Soil.
Whitehead, Charles. Mould or Mildew on Hop Plants.
———————. Profitable Fruit Farming.
———————. The Hop Failure of 1882, and its Lessons.
Wilson, A. Stephen. A Bushel of Corn.

B. Foreign Books and Pamphlets.

Butyreren. Tredie Beretning om Bygdo Kongsgaard. Christiania, 1882.
Basserie, Colonel. Drainage des Écuries et des Étables. Le Mans, 1883.
Caravia, Antonio T. Manuel Prático del Cultivador Americano. Montevideo, 1882.
Edelman, Dr. M. Th. Illustrirter Catalog No. IX. der erdmagnetischen, physikalischen, meteorologischen, physiologischen, und medicinischen Instrumente. München, 1882.
Gaedertz, Georg W. Verzeichniss der Obstbaumschulen. Stuttgart.
Gaetano, Cantoni. L'Anno Rurale 1882. Milano, 1883.
——— Coltivazione del Frumento. Milano, 1883.
Giotto Ulivi, l'Abbé. Lettre à M. le Ch. Felix Rignon sur l'Agriculture. Turin, 1883.
Klenze, Dr. von. Handbuch der Käserei-Technik mit 194 Holzschnitten und 33 autotypischen Tafeln. Bremen, 1884.
Lavalard, E. Rapports sur les opérations du service de la Cavalerie et des Fourrages de la Compagnie générale des Omnibus de Paris, pendant l'exercice 1882. Paris, 1883.
Lecouteux, Edouard. Le maïs et les autres fourrages verts, culture et ensilage. Paris, 1883.
Moll, L. and E. Gayot. La connaissance générale du Mouton. Paris, 1867.
———————. La connaissance générale du Cheval. Paris, 1883.
Pery, G. A. Estatistica Agricola do Districto de Bija. Lisboa, 1883.
Richard, A., et Edmond Boniface. De l'étude de la Comptabilité dans l'enseignement primaire. Lille, 1882.
Sagnier, Henri. La section d'agronomie au Congrès de Rouen, 1883.
Schübeler, Dr. F. C. Væxtlivet i Norge med særligt hensyn til Plantegeographien. Christiania, 1879.
Sauvage, H de. Comptabilité Agricole. Paris, 1882.
Wahlstedt, L. J. Catalogue de la Collection des Semences Suédoises à l'exposition Internationale d'Amsterdam en 1883. Lund, 1883.

THE

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY

OF ENGLAND

SECOND SERIES.

VOLUME THE TWENTIETH.

PRACTICE WITH SCIENCE.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1884.

THESE EXPERIMENTS, IT IS TRUE, ARE NOT EASY; STILL THEY ARE IN THE POWER OF EVERY THINKING HUSBANDMAN. HE WHO ACCOMPLISHES BUT ONE, OF HOWEVER LIMITED APPLICATION, AND TAKES CARE TO REPORT IT FAITHFULLY, ADVANCES THE SCIENCE, AND, CONSEQUENTLY, THE PRACTICE OF AGRICULTURE, AND ACQUIRES THEREBY A RIGHT TO THE GRATITUDE OF HIS FELLOWS, AND OF THOSE WHO COME AFTER. TO MAKE MANY SUCH IS BEYOND THE POWER OF MOST INDIVIDUALS, AND CANNOT BE EXPECTED. THE FIRST CARE OF ALL SOCIETIES FORMED FOR THE IMPROVEMENT OF OUR SCIENCE SHOULD BE TO PREPARE THE FORMS OF SUCH EXPERIMENTS, AND TO DISTRIBUTE THE EXECUTION OF THESE AMONG THEIR MEMBERS.

VON THAER, *Principles of Agriculture.*

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, STAMFORD STREET AND CHARING CROSS.

CONTENTS OF VOLUME XX.

SECOND SERIES.

APPENDIX.

DIRECTIONS TO THE BINDER.

The Binder is desired to collect together all the Appendix matter, with Roman numeral folios, and place it at the *end* of each volume of the Journal, excepting Titles and Contents, and Statistics &c., which are in all cases to be placed at the *beginning* of the Volume; the lettering at the back to include a statement of the *year* as well as the *volume;* the first volume belonging to 1839–40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In Reprints of the Journal all Appendix matter and, in one instance, an Article in the body of the Journal (which at the time had become obsolete), were omitted; the Roman numeral folios, however (for convenience of reference), were reprinted without alteration in the Appendix matter retained.

NOTE.—"Growth of Wheat at Rothamsted," &c., Appendix-Table I., pp. 1 and 2, to be so folded that the Half-title will face p. 448, and the *Table* draw out to the left, free of the book.

One copy of "Invitation for Nominations of Gentlemen qualified to act as Judges," &c. (*blue* paper), to be placed, *loose*, in each number of the Journal.

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

XV.—*On the Continuous Growth of Wheat on the Experimental Plots at Rothamsted during the* 20 *Years*, 1864 *to* 1883, *inclusive.* By Sir J. BENNET LAWES, Bart., LL.D., F.R.S., and J. H. GILBERT, LL.D., Ph.D., F.R.S.

IN the Journal of the Royal Agricultural Society of 1864 we published an article on the growth of wheat for 20 years in succession—1844 to 1863 inclusive—upon the same land. We have now to record the continuation of these experiments over a similar period of 20 years—1864 to 1883.

The 20th crop of the first period—grown in 1863—was much the largest of the whole; and, as will be seen further on, the first crop of the second period of 20 years, grown in 1864, was also the largest of the whole; further, these two crops of 1863 and 1864 were larger than any two crops grown during any of the other 38 years.

The first period comprised a number of seasons of great abundance: the second period a number of seasons of very deficient yield.

In the first period an artificial manure applied continuously to the same plot of land, produced for 10 years in succession a crop of $40\frac{1}{2}$ bushels per acre: in the second period the same plot of land, receiving exactly the same manure every year, only produced $30\frac{1}{2}$ bushels, an annual reduction of 10 bushels per acre for 10 years in succession!

Formerly, when the yield was bad, the farmer obtained compensation in the shape of higher prices for his produce, but in this case the larger crops of the first period were sold at considerably higher prices than the smaller crops of the second period. In the first period there was considerable agricultural

prosperity, while the second period has witnessed a more severe depression than any that has occurred during the present century.

An attempt to investigate the growth of wheat under circumstances so totally different from any which have ever previously arisen, could hardly be carried out without the commission of some errors which experience would have enabled us to avoid. We now know—if we wish to advance beyond the question of the best manure to grow one crop of wheat—that continuity of manuring is of supreme importance. With the exception of the plot receiving farmyard dung, and the unmanured plot—neither of which has been altered from the commencement—there is no plot in the field in which some change has not taken place in the manure applied during the early years of the experiment. But in 1851, 7 years after the experiments were commenced, the manuring of the field was arranged upon a fixed plan which—with very slight changes in one or two instances—has been continued up to the present time.

Upon the plot receiving farmyard dung, and the unmanured land, no change has taken place during the 40 years; upon most of the other plots, which comprise about 16 experiments, no change has taken place for 32 years.

In our former paper we devoted some time and space to the purpose of considering, and refuting the views held by Baron Liebig with respect to the growth of wheat. All controversy in regard to these once celebrated theories has died out. There is no question at the present time regarding the ingredients in which soils cropped repeatedly with corn are generally deficient; nor is there any question as to what substances must be applied with a view to increasing the produce. A possession of this knowledge enables us to forecast with some degree of certainty—subject of course to the influence of climate—what will be the relative yield of the various manures applied to our experimental crops, for some considerable period in advance.

Coincident with an increase of knowledge in this direction a completely new branch of enquiry has sprung up.

Analysis tells us that a very considerable proportion of the ingredients we apply to grow the crop is not found in the produce. What has become of this proportion?

Again, the greater part of the crop consists of ingredients which are not supplied. What is the source of these ingredients?

The carbon, which is the source of heat in our fires, is taken out of the soil in the form of coal. If we increase the carbon

of our crops by means of artificial manures, which do not supply any carbon, does the increase also come out of the soil?

If it does, the artificial manures will cease to be effective when all the carbon is exhausted.

Analyses of the water passing through a cultivated field show that while one very important and costly manure ingredient is there in abundance, there are others which are only there in very minute quantities.

Here, then, is a large field of investigation opened.

The soil itself, without external aid from fertilising matter, appears to be capable of producing much more growth than it was formerly credited with, and at the present time, when the provisions for compensation under the Agricultural Holdings Acts involve a distinction between the fertility which is the property of the landlord, and that which belongs to the tenant, investigations which have a direct bearing upon these questions must be both interesting and instructive. While therefore the previous paper dwelt more especially upon the influence of the manure upon the crop, the present article will enter more fully into the question of the action which takes place beneath the soil.

We propose to follow the same plan which was adopted on the previous occasion, of giving a short outline of the character of the weather of each year, illustrating its influence upon the crop by a selection of the produce from plots that have been differently manured.

Since the publication of our paper upon the growth of wheat for 20 years in succession, we have published two articles in this Journal; one, in 1868, relating to the average yield of our wheat crops from 1852 to 1868; and the other, in 1880, under the title of "Our Climate and our Wheat Crops," where we traced the character of the climate of several years in which the crops grown were remarkable, either for being very large, or very poor in their yield; it will therefore be less necessary to dwell at any length upon the character of the climate of each separate season, although the subject could not very well be altogether omitted.

Twenty-first Season, 1863–64.

October, November, and December 1863, were warmer than usual, with upon the whole rather less than the average amount of rain. Jauuary and February 1864, though including some abnormally warm intervals, embraced longer periods of very cold and wintry weather, which checked forward vegetation; there was considerably less than the average fall of rain in January, and a very slight fall, including snow, in February. In

March the rainfall was large—the first half of the month generally warm, the latter half cold—and, upon the whole, the quarter had been very variable but colder than usual with many alternations from frost to thaw. April and May were for the most part warm, with less than the average amount of rain; but the end of May and nearly the whole of June were comparatively cold, with little rain. In July and August there was less rain than is usual in these months, but an excess in September. The day temperature generally ranged high in July, but about the average in August and September; whilst the night temperature was somewhat below the average in July, much below in August, and about the average in September. In June and July the dew point was below, and in August very much below the average. The degree of humidity of the air was in June low, in July about the average, and in August considerably below the average.

Thus the winter was very variable, including a good deal of warm, but also much very cold and wintry weather, though with comparatively little rain. The spring, though changeable and wet at the beginning, was, upon the whole, warm and dry; June was cold and dry, whilst the rest of the summer was hot in the day and cold at night, with very little rain, and in August especially a very dry atmosphere.

Table I.—Summary of the Results of the Twenty-first Season, 1863–64.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c.				
		Dressed Corn.			Total Corn.	Straw and Chaff.
		Quantity.		Weight per Bushel.		
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	16	1¾	62·0	1078	1350
2	14 tons farmyard-manure	40	0	62·5	2595	3893
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	32	0¼	61·8	2093	2832
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	33	1	61·7	2182	3287
5A & B	Mixed mineral manure alone	16	3½	62·0	1087	1376
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	31	0½	62·0	1997	3379
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	45	3¼	63·1	3000	4970
9A	Mixed mineral manure, and .. .. .. 500 lbs. nitrate of soda = 86 lbs. N. ..	51	0¼	62·6	3330	5985
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	49	3½	63·5	3292	5588
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	35	1	61	..	..

Although the weather was generally too hot and dry for the lighter class of soils, the crop was a very large one on those of a heavier character. The plot manured with minerals and nitrate of soda exceeded 50 bushels per acre, and we have therefore the remarkable fact that, in two consecutive years, a crop of over 50 bushels per acre has been grown upon land which has received only artificial manures for more than twenty years.

Twenty-second Season, 1864–65.

After a rather wet September, but a very low aggregate rainfall during the first 9 months of the year, the concluding quarter of 1864 was also characterised by less rain than usual. The deficiency was very considerable in October and December, though there was rather an excess in November. As to temperature, the period was very variable, with a good deal of cold weather. There were occasionally very high winds; whilst the degree of humidity of the air was unusually low in October, and also somewhat low in November and December. In January, 1865, there was a considerable, and in February a slight excess, but in March a deficiency of rain (including snow), though, throughout the quarter, the number of rainy days was small. Excepting the first half of January, the greater part of which was warm, the quarter was almost throughout unusually stormy and cold, with a good deal of snow; March in particular was generally exceptionally cold and inclement. In April and June very little rain fell; whilst in May and July there was an excess, and in August a very great excess. In September, however, the rainfall was exceptionally small. April, May, and the beginning of June, were much warmer than the average, but the remainder of June was variable, and, upon the whole, rather cold. The mean temperature of the quarter, and especially of April, was, however, the highest on record for that period of the year; and the air was uniformly much drier than the average, as the rain which fell was not much distributed, but came for the most part in heavy showers. July, with an excess of rain, was also warmer than usual. The greater part of August was not only extremely wet, but also rather colder than usual; whilst September was both the driest and hottest on record, and—notwithstanding the comparatively low temperature of August—the average heat over the whole period of six months has never been equalled. In each month too (excepting August, when it was very high) the degree of humidity of the air was generally low.

The winter of 1864–5, though variable, was therefore, upon

the whole, very cold, stormy, and inclement, and the early spring was unusually cold and backward. Later in the spring the weather became very warm with a dry atmosphere, and towards the end, some heavy rains fell. The combined conditions brought the crops very rapidly forward. June was also dry, hot at the beginning, though afterwards comparatively cool; July was hot, with a good deal of rain, but, upon the whole, a dry atmosphere; the greater part of August was cool and very wet, but the remainder, and September, very hot and dry, favouring the rapid completion of the hitherto much retarded harvest work. Thus, after a severe winter and late spring, the growing period was characterised by great heat, dryness of atmosphere, and a deficient amount and distribution of rain; the ripening period by an excess of rain, followed, however, by an eventually favourable, though late harvest time.

TABLE II.—SUMMARY of the RESULTS of the TWENTY-SECOND SEASON, 1864–65.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity.		Dressed Corn. Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	13	1¼	60·6	828	1033
2	14 tons farmyard-manure	37	0½	61·5	2384	3100
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	25	0¾	59·6	1649	2385
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	29	2¼	59·5	2005	3137
5A & B	Mixed mineral manure alone	14	0¾	60·9	915	1176
6A & B	Mixed mineral manure, and 200 lbs. ammonium-salts = 43 lbs. N.	24	3¾	60·9	1605	2021
7A & B	Mixed mineral manure, and 400 lbs. ammonium-salts = 86 lbs. N.	40	1	61·6	2580	3669
9A	Mixed mineral manure, and 550 lbs. nitrate of soda = 86 lbs. N.	44	0¼	61·1	2881	4682
8A & B	Mixed mineral manure, and 600 lbs. ammonium-salts = 129 lbs. N.	43	2½	61·4	2833	4600
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	30	2½	61·0	..	..

The wheat crop of 1865, although much inferior to that of the two preceding years, was still above the average. The highest produce in the field was on the Mixed Mineral Manure and Nitrate Plot, which yielded 44 bushels per acre, weighing 61 lbs. per bushel. The plot receiving farmyard dung gave 37 bushels per acre, which is considerably above the average of this plot.

Twenty-third Season, 1865–66.

The very warm and dry weather of September, 1865, extended through the first week of October, and, although there were a few cold intervals, the temperatures of the three concluding months of the year ruled higher than the average, December especially being unusually warm. The period included however very great fluctuations in barometric pressure, and some extremely severe storms of wind; whilst in October an excessive, in November a full, but in December a deficient amount of rain fell. January and the first half of February (1866) were also unusually warm, though in January there was a heavy fall of snow, which however rapidly thawed, and the whole period was very wet. A cold and drier period then set in, and extended to the middle of March, checking the hitherto much too forward vegetation. After this, to the end of the quarter, the temperatures, though variable, ruled, upon the whole, very high, and there was a full amount of rain. The beginning of April was cold and rather wet, and the remainder considerably warmer and drier than the average. May was, throughout, unusually cold both by day and night, and there was a deficiency of rain. June was changeable, but included a good deal of hot weather, which raised the mean temperature above the average, and during the month a considerable excess of rain fell. The beginning of July was cold and wet; then followed a week of hot and dry weather, but, from about the middle of the month to nearly the end of September, the weather, with the exception of a few short intervals, was generally cold, with a good deal of rain and wind in August, and an excessive, and almost continuous fall in September. October was, however, upon the whole, warmer and drier than usual. In June, July, August, September, and October the degree of humidity of the air was generally high.

Thus, after a very wet and comparatively warm autumn, the winter was, until the middle of February, unusually warm, with a great deal of rain, inducing premature luxuriance of grass and winter sown crops; then came a month of cold and dry weather, checking growth. The remainder of the spring was at first very variable, but May was unusually cold and dry. The early summer was changeable, but mostly warm, with a good deal of rain; and the ripening and harvest periods were almost continuously cold and rainy, with a moist atmosphere, but with occasional high and drying winds.

The wheat crop of 1866 was one of inferior yield under all the different classes of manures, the highest produce of any one plot not reaching 33 bushels; while the estimated yield of the

crop of the country was 25 bushels per acre, calculated upon a a weight of 61 lbs.

TABLE III.—SUMMARY of the RESULTS of the TWENTY-THIRD SEASON, 1865–66.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. — Dressed Corn. Quantity.		Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	12	0½	61·3	777	1269
2	14 tons farmyard-manure	32	2½	61·7	2070	4058
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	26	1	61·2	1693	2792
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	30	3	59·9	1979	4682
5A & B	Mixed mineral manure alone	13	1	60·9	838	1465
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	20	2	61·0	1294	2248
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	29	3¾	61·0	1891	3884
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	32	2	60·6	2061	5316
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	32	0½	60·1	2054	5312
	Estimated average for the United Kingdom reckoned 61 lbs. per bushel	25	0½	61·0	..	..

Twenty-fourth Season, 1866–67.

The concluding quarter of 1866 was generally warmer than the average, though it included some cold intervals. There was somewhat less than the usual aggregate amount of rain, though a good deal fell within a short interval about the middle of November, causing floods, and hindering autumn sowing in some localities. In January, 1867, the fluctuations were very great; extreme cold and heavy falls of snow, alternating with rapid thaws, warm weather, heavy gales, and a good deal of rain. The last week of January and almost the whole of February were unusually warm, with a large amount of rain at the beginning, and a moderate quantity over the rest of the period. March, again, was almost to the conclusion very cold and wintry, with a good deal of snow. Throughout the quarter there was a succession of gales and wind. Owing to the severe weather of March, the growth of winter sown crops was checked; and owing partly to the wet, and partly to the frost, the preparation of the land for spring sowing was much retarded. April, and the beginning of May, were very unsettled; stormy, rainy, and changeable as to temperature, but, on the average,

warmer than usual. Later in May, besides some very warm weather, there was a longer period that was extremely cold, with a dry atmosphere, and frosty nights, which much checked vegetation, though, during the month, there was rather more than the average fall of rain. June was comparatively dry, very changeable as to temperature, but on the average colder than usual. The cold weather continued throughout July and the beginning of August, and the period was generally sunless and cloudy, with an excess of rain in July, which fell very heavily towards the end of the month. The crops in consequence were much laid, and in some cases were inundated. The remainder of August, and September, were much finer, and rather warmer than the average, though there was more than the average fall of rain, which however was not much distributed, but fell for the most part in considerable quantities at a time.

Thus, the early winter was, upon the whole, warmer and drier than usual; then came intervals of severe frost, snow, and heavy gales, followed by several weeks of very warm weather, with a good deal of rain. The early spring was very wintry and stormy, and growth and spring sowing were alike retarded. Later on the temperature was very changeable, being at first warmer, afterwards unseasonably cold, and frequently stormy and rainy. The rest of the growing, as well as the early ripening period, was changeable, though for the most part unseasonably cold, cloudy, and sunless, with a great deal of rain, and occasionally very heavy falls which much laid the crops. The harvest-time, though late and including some heavy rains, was however upon the whole not unfavourable for the greater portion of the Midland, Southern, and Eastern districts.

With a wet autumn, a winter alternately very mild and very severe, a spring with alternations of extreme heat, cold, frost, and wet, and a summer with a good deal of sunless weather, and occasional violent storms of wind and rain which laid the crops, the conditions were certainly not of a nature to justify the expectation of a productive harvest. Yet, both before and after the favourable change at harvest time, some writers in the 'Times' gave very sanguine views of the crops of the country at large. The records in the agricultural papers were, however, much less favourable, and the results obtained at Rothamsted led us to the conclusion that the general wheat crop would not be less than 20 per cent. below an average. Subsequent experience showed that this unfavourable estimate was only too well founded.

After the record of the climate of 1866–7 a good wheat crop could not be expected. Violent changes from heat to cold—

the latter predominating—accompanied by much rain, are not favourable to growth.

TABLE IV.—SUMMARY of the RESULTS of the TWENTY-FOURTH SEASON, 1866–67.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity.		Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	8	3½	56·1	532	973
2	14 tons farmyard-manure	27	2¼	61·4	1755	3136
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	18	0½	57·9	1123	2023
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	22	0½	57·4	1392	3246
5A & B	Mixed mineral manure alone	9	1	59·4	580	1033
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	15	3	60·5	1003	1723
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	22	0¾	61·0	1417	2762
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	29	0½	59·9	1855	4918
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	30	1¾	60·7	1952	4196
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	21	0	61·0	..	..

We had both on the unmanured plot—as also on all the other plots, no matter what description of manure had been applied—a low yield. The unmanured produce was less than 9 bushels per acre, and, except in the spring sown crop of 1853, no such low produce has been obtained. The highest produce in the field was below 31 bushels, and the average yield of the crop of the country was estimated at 21 bushels, of the calculated weight of 61 lbs.

Twenty-fifth Season, 1867–68.

October, 1867, was very variable as to temperature, upon the whole colder than usual, with comparatively little rain, but occasional high winds. There was unusually little rain in November, and the weather was for the most part clear but cold, and very favourable for working the land and sowing. December was characterised by great and rapid variations of temperature and barometric pressure, with some extremely heavy gales; occasionally frost, snow, and sleet, at other times very warm weather; in the aggregate there was a full amount of rain, and throughout the month agricultural operations were much im-

peded. The first eleven days of January, 1868, were very cold; but from that time to the end of the quarter (indeed to the end of the summer), the weather was unusually warm. There was a considerable excess of rain, and there were several gales of wind in January; but only a moderate amount of rain fell in February and March. In these months vegetation became very forward, and the weather was generally favourable for working the land and for spring sowing. April, May, and June, again, were all considerably warmer than the average. The average temperature of April had, however, frequently, and that of each of the other months occasionally been exceeded in the corresponding months of other years; but the average temperature of the three months together had only once been exceeded in any corresponding three months for 98 years (the period for which records are available), namely, in 1865, when, though April was hotter, May and June were not quite so hot as in 1868. The average temperature of the whole period, from the middle of January to the end of June, was only exceeded in 1822. Concurrently with this long continued warm weather, there was a great excess of rain in January, and only a moderate amount in February and March; there was a small excess in April, a deficiency in May, and a very great deficiency in June. Temperatures in excess of the average also prevailed almost continuously throughout the succeeding quarter, namely, to the end of September. July, in particular, was excessively warm, with at the same time a great and continued deficiency of rain; August was also warmer than the average, but with a good deal of rain; and September was still warmer than August, with a deficiency of rain. In no year of the previous 98 had the temperature so far exceeded the average for so long a corresponding period, as that from the middle of January to the end of September of this year, 1868. The total rainfall of the nine months was not much below the average; but the amount which fell was excessive in January, as also in April and in August, whilst it was deficient in each of the other months of the period, and more especially in those of the greatest heat, namely May, June, and July. The degree of humidity of the atmosphere was also lower than the average in each of the nine months from January to September inclusive, especially in June, still lower in July, and considerably lower in August and September.

The characters of this extraordinary season may be briefly summarised as follows:—After a favourable autumn seed time, the first half of the winter was very variable, including some very warm, but more stormy, wet, snowy and frosty weather. From that time to after harvest, the temperature was almost always

above the average, and very greatly so in the summer months of June and July; whilst, after a favourable spring seed time, there was a sufficiency of rain in April to give a fair start to early-sown crops; but, from that time until the harvest was nearly over, throughout the Midland, Southern, and Eastern districts of the country, the excessively high temperature was accompanied by a drought of unusual severity, both as regards the length of its duration, and the great deficiency of rain, while at the same time the atmosphere was very dry.

With the favourable autumn seed time, the area under wheat was over the average. In the spring the plant was generally good, the harvest was very early, and finally the crop was reported to be considerably above the average in both quantity and quality on good and well-farmed soils; on light and poorly farmed land, on the other hand, the crop suffered much from the heat and drought. Still, the aggregate wheat crop of the country was supposed to be about 20 per cent. over the average in quantity, and also of above average quality.

TABLE V.—SUMMARY of the RESULTS of the TWENTY-FIFTH SEASON, 1867–68.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c.				
		Dressed Corn.			Total Corn.	Straw and Chaff.
		Quantity.		Weight per Bushel.		
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	16	2½	61·0	1054	973
2	14 tons farmyard-manure	41	3	61·6	2604	4190
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	24	3	61·9	1627	2163
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	27	1	62·0	1799	2742
5A & B	Mixed mineral manure alone	17	2½	62·8	1135	1346
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	28	1½	62·8	1835	2569
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	39	3½	61·1	2468	3849
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	47	3¼	61·1	2970	5180
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	46	2	62·0	2932	4808
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	34	0	61·0	..	..

Although considerably higher yields have been obtained upon some plots than those which were grown this year, still, the yield from all the different manured plots has rarely been exceeded; the mean obtained, 34 bushels, confirming the verdict of the country regarding the general excellence of the crop.

Twenty-sixth Season, 1868–69.

The extraordinary warm period of nearly nine months' duration ended with September 1868. October and November were throughout, with very few exceptions, colder than usual both by day and night; whilst in October there was a deficiency of rain, and in November a very great deficiency. December, on the other hand, was almost throughout very much warmer than the average, with a great excess of rain, some violent gales of wind, very variable, but, upon the whole, very low barometric pressures, and a high degree of humidity of the atmosphere. The average temperature of December had indeed been exceeded only twice during the preceding ninety-eight years; namely, in 1806 and 1852. With the exception of a week after the middle of January (1869), the very warm period continued until the end of February, completing three winter months of average temperature about 6 degrees higher than the average of ninety-eight years. There was, again, a considerable excess of rain in January, and a slight excess in February. March, on the contrary, was several degrees colder than the average, with about, or less than, the average amount of rain. Early in April warm weather set in, and lasted till nearly the end of the month, the temperature during this period being several degrees higher than the average, whilst the fall of rain was generally under the average. May and June were, with few exceptions of short duration, very much colder than the average. Towards the end of May the cold was very extreme for the season, the greater part of June was also unusually cold, both by day and night; and in May there was a considerable excess, though in June a deficiency, of rain. Early in July there was again a change to warm weather, which lasted till the end of the month, during which there was very little rain. The first three weeks of August were unseasonably cold and showery, though the total amount of rain was comparatively small; but the concluding week of the month was very bright and hot. Then came a short period of cold weather, but the remainder of September was warm though stormy, with a good deal of rain. In April, May, and June, the degree of humidity of the air ranged high, especially in May; in July it was about the average, but in August and September it was below it.

To sum up the characters of the season: The heat and drought of the spring and summer of 1868 were followed by a warm and dry September, and a cold and dry October and November provided a good autumn seed-time. The three winter months were very warm and—December and January especially—very wet, which brought the autumn sown crops rapidly forward, and

provided an unusual amount of winter grazing, which greatly compensated for the previous deficiency. Owing to the condition of the land, spring sowing was retarded. The weather in March was both dry and cold, and in consequence vegetation was much checked; a rapid recovery however took place under the influence of very warm, though somewhat dry, weather in April. The remainder of the spring was very cold, and also wet; June, again, for the most part was cold, and July warm; most of August was cold, but the latter part of the month and September were hot, while the summer was comparatively dry, though the harvest-time was somewhat unsettled.

TABLE VI.—SUMMARY of the RESULTS of the TWENTY-SIXTH SEASON, 1868–69.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c.					
		Dressed Corn.			Total Corn.	Straw and Chaff.
		Quantity.		Weight per Bushel.		
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	14	1	56·1	848	1350
2	14 tons farmyard-manure	38	1	56·9	2256	3937
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	20	1	54·9	1210	2265
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	24	0½	54·6	1452	3475
5A & B	Mixed mineral manure alone	15	3	56·9	942	1601
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	21	2½	57·2	1309	2265
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	28	1¾	57·5	1760	3212
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	39	0	57·1	2368	4930
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	34	3	57·2	2096	3918
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	27	0	61·0	..	..

The extreme fluctuations of temperature which marked this season are visible in the very low quality of the produce: in only one experiment does the weight of the bushel reach 58 lbs., while the yield of the crop generally was large, and even when calculated upon a standard of 61 lbs. per bushel, was slightly over an average.

Twenty-seventh Season, 1869–70.

Until the middle of October the autumn of 1869 was for the most part warm, with a good deal of rain. From that time until the end of the year the weather—though including some rapid

fluctuations, some very warm days, and a warm period of more than a week in the middle of December—was very cold and inclement, and especially wintry towards the end of October. There were numerous gales throughout the quarter; while there was less rain than usual in October, about the average in November, and a considerable excess in December. The falls were heavy and continuous at the end of November, and again in the middle of December; while the drains in the experimental wheat-field ran frequently from November 28th, 1869, to January 1st, 1870. The first three months of 1870 were characterised by frequent alternations of warm, and very cold weather—the colder periods being, however, much the longer, and sometimes very severe; snow was very frequent, but the rain gauge indicated a deficient fall in January, in some localities a deficiency in February, but a very heavy fall early in the month, and an excess in March. From early in April to near the end of the month the weather was very warm and dry; then followed about a fortnight of cold and cloudy weather, from which time until nearly the end of June it was again very warm, sunny, and dry—the three months together being not only warmer than the average, but very unusually deficient in rain. The day temperature especially was high, though the night temperature in April and May was low, but in June high. The end of June and the beginning of July were cold and variable, but the remainder—indeed, nearly the whole of July, as well as the first half of August—was very warm. Then, to the end of September, a period of about six weeks, the temperature was generally below the average, though the weather continued fine. Thus, the period of drought, which had commenced with April, continued to nearly the end of August, and even in September there was less than the average fall of rain. The large deficiency of rain throughout five consecutive months was, moreover, accompanied by great dryness of atmosphere—the degree of humidity of the air being in April unusually low, and in May, June, July, and August, also considerably below the average.

The autumn of 1869, though, as the details show, frequently cold, boisterous, and inclement was upon the whole not unfavourable for getting in the seed. The winter, though changeable, included a great deal of very cold weather. In the early spring both field-work and vegetation were very backward, and at the end of April grass land was very brown and bare. From the beginning of April until harvest the weather—with few exceptions of short duration—was warmer than usual, with a great deficiency of rain, and a very dry atmosphere.

The combined heat and drought were even more extreme during the months of May, June, and July 1868, than during

the corresponding months in 1870; but in the latter year the deficiency of rain commenced a month earlier, and continued later than in 1868. The grass crops in consequence suffered much more in 1870; and, for a parallel, we must go back as far as 1844. As in the two preceding years (1868 and 1869), the reports of the cereal crops of the country were very variable, but for very opposite reasons in the years of heat and drought, 1868 and 1870, as compared with 1869.

TABLE VII.—SUMMARY of the RESULTS of the TWENTY-SEVENTH SEASON, 1869–70.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity. bush.	pks.	Weight per Bushel. lbs.	Total Corn. lbs.	Straw and Chaff. lbs.
3	Unmanured	14	$3\frac{3}{4}$	61·8	956	1046
2	14 tons farmyard-manure	36	2	63·4	2359	2733
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	21	$2\frac{3}{4}$	60·8	1420	1627
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	26	$1\frac{3}{4}$	61·3	1735	2080
5A & B	Mixed mineral manure alone	18	$2\frac{3}{4}$	62·6	1203	1360
6A & B	Mixed mineral manure, and .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	30	$1\frac{3}{4}$	63·1	1980	2354
7A & B	Mixed mineral manure, and .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	40	$2\frac{1}{4}$	63·3	2620	3216
9A	Mixed mineral manure, and .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	45	2	62·7	2940	3911
8A & B	Mixed mineral manure, and .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	45	1	63·8	2966	3667
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	30	0	61·0	..	..

Although the yield of wheat in this exceedingly dry season was lower than in 1868, the weight of the grain was considerably higher, reaching in one experiment nearly 64 lbs. per bushel.

The ravages of wireworm were very general throughout the country; this considerably reduced the yield of the crop, which otherwise would have been a large one.

Twenty-eighth Season, 1870–71.

In October 1870 the changes of temperature were very frequent, giving however about the average for the month; and there was a slight excess of rain. The first 19 days of November were for the most part cold, while the remainder was warm, but the average for the month was low, and there was a con-

siderable deficiency of rain. There were about 10 days of very warm weather in the middle of December, but the beginning and end of the month were cold; the latter extremely so, with a good deal of snow and cold wind; the average for the month was 5 or 6 degrees below the average for 99 years; and the rain and melted snow indicated a considerable excess of fall. January 1871, with the exception of a few days in the middle of the month, was cold; and at the beginning, and for nearly a fortnight at the end, the weather was extremely severe. From early in February until the middle of March the weather was very mild, but from thence to the end of the month the temperature was very variable. There was a full amount of rain (or snow) in January, but a deficiency in both February and March; though the melting of the snows of January, succeeded by frequent rains early in February, caused floods in many parts. April, May, and June were—with the exception of the latter half of April, which was warm, with a good deal of south-west wind and rain—unusually cold, with a great deal of east or north wind, or some compound of the two; and there was an excess of rain in April and June but a deficiency in May; June especially being very unseasonably cold and wet. July, excepting about a week after the middle of the month, was cold, with a considerable excess of rain; but, from early in August to about the middle of September, there was a period of six weeks of warm and genial weather, from which time till the end of September, it was again very cold, wet, and stormy. August was not only warm, but there was very little rain, whilst in September there was, towards the end of the month, a great excess of rain. The degree of humidity of the air was high in April and June, rather high in July, rather low in May, very low in August, and low in September.

The autumn of 1870 was thus changeable as to temperature, being upon the whole, cold; wet prevailed during the first half of September, and also of October, but afterwards the weather was comparatively dry and favourable for field work. The greater part of the winter was extremely severe, with a good deal of snow and very cold winds; the remainder was mild and very wet, retarding field work and spring sowing. Winter corn was very backward, and in many cases injured, pastures were bare, and vegetables very scarce. The hard winter had, however, killed many insects, and March was favourable for field work and sowing; but, with the exception of the latter half of April, the remainder of the spring was cold and backward. The rest of the active growing period, excepting one or two intervals of short duration, was cold, bleak, and very wet. In the greater part of England, however, August and the early

part of September being warm and dry, much aided the ripening and getting in of the crops; but the latter half of September was cold and wet.

TABLE VIII.—SUMMARY of the RESULTS of the TWENTY-EIGHTH SEASON, 1870–71.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. — Dressed Corn. — Quantity.		Dressed Corn. — Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	9	$1\frac{1}{4}$	54·8	615	1100
2	14 tons farmyard-manure	38	$3\frac{3}{4}$	60·0	2498	4506
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	10	$0\frac{1}{2}$	53·8	675	1252
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	17	$2\frac{1}{2}$	52·4	1093	2425
5A & B	Mixed mineral manure alone	11	$3\frac{1}{2}$	56·6	773	1435
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	17	0	56·5	1089	2297
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	22	1	56·7	1512	3085
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	34	$1\frac{3}{4}$	58·6	2228	4909
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	27	$2\frac{3}{4}$	57·7	1843	3933
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	24	0	61·0	..	..

Both in quantity and quality the wheat crop of this season was much below an average. The dunged land, which yielded nearly 39 bushels, weighing 60 lbs. per bushels, shows, what may be noticed generally throughout the experiments, that while the crop upon the dunged land is able to resist the influence of bad weather better than those grown by artificial manures, it cannot, under very favourable weather, attain the produce which is reached by the crops receiving artificial manures.

The estimated produce of the selected experiments gives 24 bushels per acre, at 61 lbs. per bushel.

Twenty-ninth Season, 1871–72.

October, November, and December, were all months of excessive cold, with very little rainfall. Mr. Glaisher observed that the quarter had been remarkable for the longest continuance of low temperature in November, and the first half of December, that had occurred in this century.

This was followed by nearly three months of very warm weather, which lasted until the middle of March. The 17th of

March was $9\frac{1}{2}$ degrees above the average, and the 21st was 12 degrees below it. October, November, and December, were dry months, while in January and March the rainfall was in excess. April was a warm month. All the month of May and the first half of June were cold, the remainder of June was warm. The rainfall was below the average in April and June, but rather above it in May. The first week in July was excessively hot; this was followed by ten days of cold weather, after which came eleven days of very great heat. August was cold and wet, while the rainfall in July was slightly below the average. In August and September frequent and heavy rains, and thunder-storms, interrupted harvest operations.

TABLE IX.—SUMMARY of the RESULTS of the TWENTY-NINTH SEASON, 1871–72.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity.		Dressed Corn. Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	10	$2\frac{3}{4}$	59·0	705	1152
2	14 tons farmyard-manure	32	$1\frac{1}{2}$	60·7	2046	3761
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	18	0	56·8	1178	2442
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	23	$1\frac{1}{2}$	55·5	1434	3210
5A & B	Mixed mineral manure alone	12	$3\frac{1}{4}$	60·0	835	1331
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	20	2	60·2	1304	2567
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	29	$2\frac{3}{4}$	60·2	1937	3827
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	40	$2\frac{3}{4}$	60·0	2565	6527
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	35	$2\frac{1}{4}$	60·5	2324	5071
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	24	0	61·0	..	..

The season of 1872 was much more favourable for artificial manures than the season of 1871, their produce having in one instance reached 40 bushels per acre; while the weight per bushel over the whole field was very much higher than in 1871: the yield of the crop of the country, however, was estimated to be considerably below an average.

Thirtieth Season, 1872–73.

October was cold until the 25th, a warm period then set in which lasted until the 9th of November, when the weather again became cold. The first part of December was cold, the

latter part unusually warm, and all the three months were excessively wet, over eleven inches of rain having fallen at Greenwich during that period.

The first fortnight in January was warm, and the remainder of the month about an average temperature. February was rather cold, and March about an average. The rainfall was slightly in excess in January and February, and slightly below the average in March. April was cold, especially towards the latter part of the month. From the 22nd of April to the 18th of June the mean temperature was $2\frac{1}{4}$ degrees below the average, the remainder of June was warm. April and May were very dry months, while the rainfall in June was above the average. July was cold up to the 19th when a few days of excessively hot weather occurred, followed again by cold. The temperature of the month was on the whole above the average.

The rainfall in July was below the average. August was alternately hot and cold, with a great deal of rain; the character of the season was one of great fluctuations, as the temperature during the winter was very warm, and the spring and early summer were very cold, while there was a good deal of rain to interfere with the ripening of the corn.

TABLE X.—SUMMARY of the RESULTS of the THIRTIETH SEASON, 1872–73.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre. Dressed Corn. Quantity.		Produce per Acre. Dressed Corn. Weight per Bushel.	Produce per Acre. Total Corn.	Produce per Acre. Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	11	$2\frac{3}{4}$	57·0	701	902
2	14 tons farmyard-manure	26	3	58·1	1622	2463
10A	400 lbs. ammonium-salts = 86 lbs. N. ..	19	$2\frac{1}{2}$	56·1	1173	1635
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	21	$3\frac{1}{4}$	54·9	1303	2358
5A & B	Mixed mineral manure alone	12	$2\frac{3}{4}$	56·9	763	1043
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	15	$3\frac{1}{2}$	57·1	960	1520
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	21	$3\frac{3}{4}$	57·2	1323	2021
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	35	$3\frac{1}{4}$	57·1	2160	3932
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	27	2	56·9	1643	2664
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	22	2	61·0	..	..

The history of the climate is quite sufficient to account for the badness of the wheat crop; the produce of the farmyard

dung did not quite reach 27 bushels, and the highest produce in the field only amounted to 35 bushels per acre; while the highest weight per bushel in the field was 57 lbs. The crop of the country was estimated to be greatly below an average.

Thirty-first Season, 1873–74.

The temperature in October fluctuated very much; sometimes it was much above the average warmth, and at others it was very cold; on the whole, however, the temperature was colder than the average, while in November it was some degrees warmer than the average. December was above the average. The rainfall in October was slightly below the average, in November slightly above it; while in December hardly any rain fell during the month.

TABLE XI.—SUMMARY of the RESULTS of the THIRTY-FIRST SEASON, 1873–74.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity.		Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	11	1¾	58·3	694	990
2	14 tons farmyard-manure	39	1	60·2	2431	4439
10A	400 lbs. ammonium-salts = 86 lbs. N. ..	25	1	56·5	1476	1977
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	21	2	57·5	1269	2166
5A & B	Mixed mineral manure alone	13	0	59·1	794	880
6A & B	Mixed mineral manure, and 200 lbs. ammonium-salts = 43 lbs. N. ..	25	3¼	59·6	1556	2221
7A & B	Mixed mineral manure, and 400 lbs. ammonium-salts = 86 lbs. N. ..	39	1¾	59·8	2449	4645
9A	Mixed mineral manure, and 550 lbs. nitrate of soda = 86 lbs. N. ..	38	0¾	60·4	2409	5012
8A & B	Mixed mineral manure, and 600 lbs. ammonium-salts = 129 lbs. N. ..	40	2	59·9	2554	6063
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	29	1	61·0	..	..

The temperature of January, February, and March was in excess of the average. January was unusually warm, the excess of temperature being 5½ degrees during the whole month. The rainfall was below the average in each of the three months, being not more than one-half the usual fall. April was an exceedingly warm month, the temperature being on several days 10 to 13 degrees over the average. The first three

weeks of May were exceedingly cold; this was followed by very warm weather which continued until the 11th of June, after which cold weather prevailed until the end of the month. April was a dry month; May excessively dry, the rainfall at Greenwich not amounting to half an inch. The rainfall in June was slightly over the average. In July there were frequent and severe fluctuations of temperature, but on the whole the month was hotter than usual.

To sum up—the climate of the wheat year of 1873–74 may be said to have been one of unusual dryness from beginning to end; of high temperature in the autumn, winter, and early spring, but after this the weather was cold until July.

The yields under the best artificial manures and the dung were very similar, amounting to from 38 to 40 bushels per acre, and the quality of the corn was fairly good. The yield of the crop of the country was estimated to be over an average.

Thirty-second Season, 1874–75.

The month of October, and November until the 20th was warm, the temperature being nearly 2 degrees over the average; but on the 20th a bitterly cold period set in and continued until the end of December. The mean temperature of the period was more than 6·6 degrees below the average—some days being 10 and one day 14 degrees below it. The rainfall in October was slightly in excess of the average. November and December were both dry months, especially the latter, and the total rainfall during the year was 20 inches, which is $5\frac{1}{2}$ inches below the average. January was exceedingly warm, the mean temperature of the month being $6\frac{3}{4}$ degrees over the average; this was followed by a very cold period which continued until the end of March. The rainfall was in considerable excess in January, and below the average in the two succeeding months. April was a very cold month, and on the 27th vegetation was very backward; but this cold was followed by a warm growing period which continued until the 10th of June, when vegetation was as forward as usual. The remainder of June was cold. The rainfall in April and May was slightly below the average, and in June slightly above it. The cold weather which set in on the 10th of June continued all through the month of July and until the 5th of August, when there came a warm period which lasted for a long time. The rainfall of July was excessive, causing great floods and doing much injury to the hay and corn crops; in some districts from 3 to 5 inches of rain fell in one day.

TABLE XII.—SUMMARY of the RESULTS of the THIRTY-SECOND SEASON, 1874–75.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. — Dressed Corn. Quantity.		Dressed Corn. Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	8	$2\frac{1}{2}$	60·0	567	1008
2	14 tons farmyard-manure	28	$3\frac{1}{4}$	60·6	1890	3719
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	12	3	54·5	786	1574
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	16	2	55·7	1050	2363
5A & B	Mixed mineral manure alone	9	1	59·4	590	1125
6A & B	Mixed mineral manure, and 200 lbs. ammonium-salts = 43 lbs. N. ..	16	$1\frac{1}{4}$	60·3	1065	2008
7A & B	Mixed mineral manure, and 400 lbs. ammonium-salts = 86 lbs. N. ..	25	$3\frac{1}{2}$	59·5	1688	3422
9A	Mixed mineral manure, and 550 lbs. nitrate of soda = 86 lbs. N. ..	30	2	57·9	1965	4747
8A & B	Mixed mineral manure, and 600 lbs. ammonium-salts = 129 lbs. N. ..	29	$3\frac{3}{4}$	58·2	1937	4323
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	22	$3\frac{1}{2}$	61·0	..	..

The season was remarkable for the great floods which prevailed all over England in the month of July; these did considerable damage to the wheat crop, and both on the dunged and artificially manured land the yield was 10 bushels per acre less than that of the previous year. The yield of the country was estimated to be greatly below an average.

Thirty-third Season, 1875–76.

October was generally cold and wet; November up to the 19th was rather warm; this was followed by a period of extremely cold weather, with a considerable fall of snow, which, owing to the high winds, did not cover the wheat, but drifted to the hedges. The weather of this period was very similar to that of 1874; but this year the cold came to an end on the 17th of December, when warm weather prevailed until the close of the year.

The rainfall was greatly in excess in October, slightly so in November, and below the average in December. January was alternately very warm and extremely cold, the cold, however, predominating; the middle of February was also very cold, but the latter part of the month and the beginning of March were unusually warm; this was followed by three weeks

of very cold weather, but the last three days of the month were very warm. The rainfall in January and February was below the average, while in March it was slightly above it. The first nine days in April were excessively warm, but the weather which followed was very severe, and from the 11th to the 14th a great amount of snow fell; the last ten days of the month were warm. Throughout the month of May the cold was excessive, and continued so up to the 18th of June; the remainder of June was warm. The rainfall during the three months was much below the average, being not more than 3½ inches over the whole period. The months of July and August were exceedingly fine and hot, and in the middle of July several days were recorded on which the temperature was over 90 degrees; very little rain fell during this month.

TABLE XIII.—SUMMARY of the RESULTS of the THIRTY-THIRD SEASON, 1875–76.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c.				
		Dressed Corn.			Total Corn.	Straw and Chaff.
		Quantity.		Weight per Bushel.		
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	8	0½	59·0	500	642
2	14 tons farmyard-manure	23	3¼	62·4	1545	2140
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	12	0½	57·2	719	922
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	13	0	56·3	766	1217
5A & B	Mixed mineral manure alone	10	2	59·2	645	785
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	15	2¾	62·1	1022	1297
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	23	2	63·0	1582	2212
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N... ..	33	1¼	62·7	2255	3584
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	29	2½	62·9	1975	2936
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	25	0	61·0	..	..

The quality of the crop of 1876 was much over an average, reaching in one case to 63 lbs. per bushel, but the yield was bad, the highest produce in the field only slightly exceeding 33 bushels per acre. The dunged plot was exceptionally bad, amounting only to a little over 23 bushels per acre. The crop of the country was considered to be superior to that of 1875, but still was below an average.

Thirty-fourth Season, 1876–77.

October was very warm and wet till the 20th; the remainder of the month was dry and cold. In November the cold period continued until the 13th; from that time until the end of the year the weather was very warm. The rainfall in November was rather over the average, and the wettest December of which there is any record followed. The rainfall in London was slightly below, and at Rothamsted slightly above 6 inches. In January and February the temperature was much above the average, and rain fell almost continuously. The first three weeks of March were cold; the latter part of the month was warm, and the rainfall was a little over the average. The first part of April was warm, but on the 11th a cold period set in which continued until the end of the month. May was a remarkably cold month; during many nights there was frost, and in some places the thermometer went down to 13, that is to say, 19 degrees below freezing-point! June was a very hot month. In April the rainfall was in excess, and in May and June it was below the average. July was a very cold month, with an average rainfall. August was a warm month until the 21st, after that, and during the whole of September, the weather was excessively cold. Mr. Glaisher stated that the mean temperature of September 1877 was the lowest recorded for 74 years. The rainfall was in excess in August, and deficient in July and September.

TABLE XIV.—SUMMARY of the RESULTS of the THIRTY-FOURTH SEASON, 1876–77.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity		Dressed Corn. Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	8	3½	58·9	543	748
2	14 tons farmyard manure	24	0½	59·1	1481	2266
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	17	0¾	57·5	1031	1322
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	27	2¾	58·0	1654	2540
5A & B	Mixed mineral manure alone	11	2¾	57·1	688	882
6A & B	Mixed mineral manure, and .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	14	2¼	58·2	876	1176
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	19	3½	59·2	1213	1835
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. .	40	0½	57·9	2383	3852
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	24	3	59·2	1510	2244
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	26	2	61·0	..	..

Although the yield of one of the plots manured with artificial manure reached 40 bushels per acre, the quality of the wheat was very inferior. The produce of the unmanured and dunged land was almost the same as that of 1876, being respectively $8\frac{3}{4}$ and 24 bushels per acre. The crop of the country, although below the average, was estimated to be rather better than that of 1876.

Thirty-fifth Season, 1877–78.

October was on the whole a fine dry month, but on the 14th there was a great gale which caused much damage. November was wet, and another severe gale occurred on the 11th. December was generally warm, with an average amount of rain. The temperature of the quarter was slightly above, and the rainfall slightly below the average. Up to January 25th the weather was exceedingly warm; after that date a cold period set in which continued until the 12th of February. From February 13th until March 13th, the weather was unusually mild, the temperature sometimes exceeding 60 degrees; a few days of cold weather followed, succeeded by four days of great warmth. On March 23rd the weather became bitterly cold with heavy falls of snow and severe frosts which continued until April 10th. On that and the following day a great fall of rain occurred amounting in some places to two and three inches in twelve hours. The whole month of April, after the 10th, was

TABLE XV.—SUMMARY of the RESULTS of the THIRTY-FIFTH SEASON, 1877–78.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. — Dressed Corn. — Quantity.		Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	12	$1\frac{1}{4}$	59·0	776	1081
2	14 tons farmyard-manure	28	1	60·9	1890	4042
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	27	$1\frac{1}{2}$	59·5	1708	2762
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	23	$1\frac{1}{2}$	56·9	1408	2897
5A & B	Mixed mineral manure alone	14	$1\frac{3}{4}$	58·8	900	1322
6A & B	Mixed mineral manure, and 200 lbs. ammonium-salts = 43 lbs. N.	22	3	60·8	1446	2944
7A & B	Mixed mineral manure, and 400 lbs. ammonium-salts = 86 lbs. N.	31	1	60·6	2065	4952
9A	Mixed mineral manure, and 550 lbs. nitrate of soda = 86 lbs. N.	37	$0\frac{3}{4}$	59·2	2333	5624
8A & B	Mixed mineral manure, and 600 lbs. ammonium-salts = 129 lbs. N.	38	$0\frac{1}{2}$	60·3	2469	6173
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	30	0	61·0	..	..

warm and wet. May was warm and wet up to the 15th, when a cold period set in which continued until June 19th; the remainder of June was very hot. The rainfall of the quarter was more than 13 inches, being about twice the ordinary fall. July was rather cold up to about the middle of the month, but the latter half was very hot, and fortunately dry weather prevailed throughout the month. Some heavy thunderstorms occurred in the beginning of August and the whole month was unsettled.

Although in no one instance did the produce reach the standard of 1877, still the general yield of the crop was very much better. The unmanured land—which for the last three seasons had not reached 9 bushels—was over 12 bushels, and the dunged plot yielded 4 bushels per acre over the produce of the last two years. It was estimated that the crop of the country was above the average.

Thirty-sixth Season, 1878–79.

Up to October 21st the weather was fine and warm, but on the 22nd it became cold and wet and remained so until December 6th, when severe frosts set in which continued until the 26th. After this the weather became unusually warm.

The character of the quarter may be summarised as follows. A good seed time, followed by intensely cold, wet weather which hardly ceased until the year ended. In some days in December the temperature was 17 degrees below the average, and the whole month was 6 degrees below the average.

January was one of the coldest months ever recorded, the thermometer during the whole month being below 32° F.; snow covered the ground, the days were nearly sunless, and the wind N., N.E. February was also very cold, with a great excess of rain, and a great deal of snow. March was first warm, then cold, and on the 21st very cold with snow; but the last days of the month were warm. The five months ending March 31st may be described as exceedingly cold with much rain and snow. The next three months may be summed up in a few words as cold, wet, and sunless; while Mr. Glaisher further informs us that for lowness of temperature the eight months ending with June have only been once exceeded during the one hundred years and upwards which have elapsed since the first records were kept at Greenwich.

July was dull, cold, and sunless; rain fell every day during the first half of the month, and frequently afterwards, sometimes mixed with snow. August was a very cold, wet month; there were a few warm days, during which no rain fell, and there

were a few fine dry days in the early part of September, after which rain fell almost daily until the end of the month.

TABLE XVI.—SUMMARY of the RESULTS of the THIRTY-SIXTH SEASON, 1878–79.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity.		Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	4	$2\frac{3}{4}$	52·5	330	763
2	14 tons farmyard-manure	16	0	56·8	1064	2239
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	3	$3\frac{3}{4}$	48·9	272	889
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	4	$2\frac{1}{4}$	49·8	345	1070
5A & B	Mixed mineral manure alone	5	$2\frac{3}{4}$	53·5	384	855
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	10	2	56·5	691	1592
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	16	1	56·7	1051	3012
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	21	$3\frac{3}{4}$	56·5	1462	4347
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	20	$2\frac{1}{4}$	56·5	1351	4176
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	15	2	61·0	..	..

We have already written so fully upon the crop of 1879 in the Journal of this Society, vol. xvi. part i. 1880, that it will be sufficient to say here, that it was not only by far the worst crop grown during the forty years of our experiments, but it was certainly the worst grown in Great Britain since the year 1816. It will be enough to give one instance. On plot 7 the yield in 1863 was 53 bushels per acre, while the same manure in 1879 was only competent to produce 16 bushels! It was estimated that the crop of the country was not much more than half an average one.

Thirty-seventh Season, 1879–80.

October was both cold and sunless, but at the same time exceedingly dry. November and December were also both cold and dry; there is, in fact, no record of so cold a December since the beginning of the century. January was exceedingly cold and dry, hardly any rain falling from the beginning to the end of the month. February was warm, with a rainfall over the average. March was warm during the first half of the month, and afterwards cold, but very dry. April was alternately cold and warm, the latter predominating; the rainfall was slightly

over an average, which, following so dry a March, was very beneficial. May was cold and dry, the nights being very cold, and vegetation was backward. June was very cold and unsettled during the first half of the month; afterwards the weather became warmer, and from the 19th to the 26th thunderstorms were frequent, with heavy rain and hail which greatly damaged the crop.

July was dull, unsettled, and wet. Thunderstorms were frequent from the 14th to the 16th. The fall of rain was in some places over 3 inches; while in others hailstorms occurred, which did considerable injury to the crops. Up to August 8th the weather was cold and wet, but after this date it was fine to the end of the month. The first week in September was very fine and hot, but during the rest of the month there was a great deal of wet.

TABLE XVII.—SUMMARY of the RESULTS of the THIRTY-SEVENTH SEASON, 1879–80.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c.				
		Dressed Corn.			Total. Corn.	Straw and Chaff.
		Quantity.		Weight per Bushel.		
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	11	2	56·9	689	1149
2	14 tons farmyard-manure	38	$1\frac{1}{4}$	60·2	2373	3902
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	10	$2\frac{1}{2}$	54·9	645	1242
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	10	$1\frac{3}{4}$	53·5	654	1420
5A & B	Mixed mineral manure alone	17	$2\frac{3}{4}$	59·2	1083	1735
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	26	$3\frac{3}{4}$	59·8	1664	2911
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	34	2	59·8	2149	4006
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	34	$0\frac{1}{4}$	57·8	2130	4394
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	35	$1\frac{1}{4}$	59·1	2203	4476
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	30	0	61·0	..	..

The wheat crop of 1880 gave a higher produce—38 bushels per acre—on the plot which receives farmyard-manure than was obtained upon any of the artificially manured plots. The large store of latent fertility in the dunged plot—which may become active at any moment—makes the yield of wheat in this plot subject to fluctuations of a different character from those of the other manured plots. The estimated yield of the crop of the country was rather above the average.

Thirty-eighth Season, 1880–81.

October was excessively cold and wet. On the 20th there was a heavy snowstorm, which was however much heavier in the south of England than elsewhere. The wheat was got in with great difficulty, and much land was left unsown. November was alternately cold and warm, and rain fell every day from the 8th to the 26th. December was a mild month, and the first half was dry, after which the rain was continuous until the end of the year.

The first few days in January were fine, after which very bad weather set in and snow fell on every day except one from the 9th to the 27th. February was a wet, cold, and gloomy month with frequent falls of snow. March was cold at the beginning and at the end of the month, but warm between the 4th and the 20th. The rainfall of the month was slightly below the average. The quarter was remarkable for the great falls of snow. April was a very dry month; cold at the beginning, warm from the 10th to the 18th, and moderately cold afterwards. May was generally cold, and on the 10th and 11th a very severe frost occurred, causing great damage to the crops. The weather was afterwards variable but on the whole cold. June was alternately cold and hot, the temperature of the month being about equal to the average, while the rainfall was slightly below the average.

TABLE XVIII.—SUMMARY of the RESULTS of the THIRTY-EIGHTH SEASON, 1880–81.

Plots.	Manures. (Quantities per Acre).	Produce per Acre, &c.				
		Dressed Corn.			Total Corn.	Straw and Chaff.
		Quantity.		Weight. per Bushel.		
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	13	3	58·0	863	1146
2	14 tons farmyard-manure	30	0¾	58·9	1907	2367
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	18	0¾	58·4	1168	1297
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	22	3	58·5	1424	1817
5A & B	Mixed mineral manure alone	12	2¾	57·9	806	903
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	21	2¾	57·8	1358	1629
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	26	2¾	58·8	1714	2203
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	35	1¾	58·4	2271	3640
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium salts = 129 lbs. N. ..	30	2¾	59·1	1962	2906
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	24	0	61·0	..	..

July was a month remarkable for the variations of temperature in Great Britain; in some districts the temperature exceeded 90, and for days together 80, while in others the month was cold, cloudy, and wet. In the wheat-districts it may be said to have been a very hot and dry month. The first week in August was fine and dry, after which the weather to the end of the month was cold with almost constant rains, which did considerable injury to the wheat.

Thirty-ninth Season, 1881–82.

October was excessively cold, with violent gales, and rainfall slightly below the average. November was exceedingly warm, with rainfall also slightly below the average. December was alternately warm and cold, the temperature and the rainfall being about the average.

January was excessively warm and dry, spring flowers being in bloom. February and March were also both warm and dry, and vegetation was very forward; indeed, from November to the end of March the weather may be described as being most favourable for the crops. April was generally warm until towards the end of the month, with more than an average rain-

TABLE XIX.—SUMMARY of the RESULTS of the THIRTY-NINTH SEASON, 1881–82.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c.				
		Dressed Corn.			Total Corn.	Straw and Chaff.
		Quantity.		Weight per Bushel.		
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	10	$3\frac{3}{4}$	58·7	679	1095
2	14 tons farmyard-manure	32	$2\frac{3}{4}$	59·6	2004	3993
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	23	$2\frac{3}{4}$	60·7	1557	2796
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	24	$1\frac{1}{4}$	58·0	1520	3617
5A & B	Mixed mineral manure alone	12	2	58·5	777	1281
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium-salts = 43 lbs. N. ..	23	$0\frac{1}{2}$	60·8	1467	2919
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	35	$3\frac{1}{4}$	60·0	2251	5730
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	31	$3\frac{1}{4}$	59·8	2012	6274
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	37	0	59·1	2323	7110
Estimated average for the United Kingdom reckoned at 61 lbs. per bushel		25	$2\frac{1}{2}$	61·0	..	..

fall. May—except during one week at the commencement—was a warm and growing month, and the rainfall was less than the average. June was cold and unseasonable throughout, with an excess of rain which seriously damaged the luxuriant crop of hay. July was cold, wet, and ungenial, and this weather, following upon a cold and wet June, seriously interfered with the ripening of the corn. The beginning of August was fine, followed by cold and showery weather on the 14th; the rainfall was, however, low.

The produce of this crop, on the whole, does not differ much from that of 1881. It may be observed, however, that while the yield of the nitrate of soda plot was almost the same in both years, the salts of ammonia gave very much more produce in the present year.

Fortieth Season, 1882–83.

The first half of October was warm, the second half cold, and the whole month was excessively wet. In consequence, the wheat was got in very badly. November was alternately warm and cold, with an average rainfall. The land was very wet all the month. The first half of December was very cold, the second half was warm, snow fell frequently, and the rainfall was over the average. January was warm throughout, with a great deal of rain and heavy storms from the 24th to the 28th. February was mild throughout the month, with excessive wet during the first three weeks. After March 6th the temperature was very cold and dry, and what little moisture fell was in the form of snow. The beginning of April was warm, but from the 9th to the 25th the weather was cold, snow falling on several days. Both March and April were favourable for farming operations.

The first twelve days of May were cold, after which the weather was fine and warm until the end of the month. June was an unsettled month, being first warm, then cold and warm alternately. It was very cold from the 15th to the 22nd, and unsettled to the end of the month. The rainfall was below the average. July was fine and warm until the 10th, the remainder of the month was cold and unsettled, with rain a little above the average. August was cold at the beginning, and warm generally afterwards, with a good deal of bright summer weather and but little rain. September, which is usually a good harvest month, was generally favourable except in the north.

Although the yield of this crop, both on the unmanured, as also on the variously manured plots was considerably over an

average, it was not considered that more than an average crop was grown throughout the country.

TABLE XX.—SUMMARY of the RESULTS of the FORTIETH SEASON, 1882–83.

Plots.	Manures. (Quantities per Acre.)	Produce per Acre, &c. Dressed Corn. Quantity.		Weight per Bushel.	Total Corn.	Straw and Chaff.
		bush.	pks.	lbs.	lbs.	lbs.
3	Unmanured	13	3¼	61·2	872	1006
2	14 tons farmyard-manure	35	0¾	62·4	2244	2930
10A	400 lbs. ammonium-salts alone = 86 lbs. N.	17	2	60·4	1196	1419
9B	550 lbs. nitrate of soda alone = 86 lbs. N.	19	0½	59·6	1337	1684
5A & B	Mixed mineral manure alone	15	2¾	61·9	1009	1138
6A & B	Mixed mineral manure, and .. .. .. 200 lbs. ammonium salts = 43 lbs. N. ..	27	2½	62·8	1781	2605
7A & B	Mixed mineral manure, and .. .. .. 400 lbs. ammonium-salts = 86 lbs. N. ..	36	0½	62·9	2378	3632
9A	Mixed mineral manure, and .. .. .. 550 lbs. nitrate of soda = 86 lbs. N. ..	43	1½	62·1	2905	5127
8A & B	Mixed mineral manure, and .. .. .. 600 lbs. ammonium-salts = 129 lbs. N. ..	41	3¼	63·5	2783	4291
	Estimated average for the United Kingdom reckoned at 61 lbs. per bushel	28	0	61·0	..	..

Best and Worst Seasons.

Every one engaged in farming knows that the growth of his crops is dependent upon the weather; still, the treatment of land in common practice is not so uniform as to enable any one to measure the influence of climate upon any particular crop. To do this the crop must be grown continuously upon the same land, and no change must be made in the manures applied.

During the period of forty years that has elapsed since the commencement of the continuous wheat crop, it is probable that we have experienced fluctuations of season as great as are likely to occur in any similar period. In the following table (p. 424) will be found the produce of selected plots, in the year of the greatest produce, 1863, and in that of the worst produce in 1879, together with the average produce of the period of thirty-two years.

The reason for giving the average of the last 32 years, instead of that of the whole period of 40 years, is that in the early years of the experiments some changes in the manures applied took place on certain plots, while for the last 32 years, the same manures have been used almost without change.

WHEAT YEAR AFTER YEAR ON THE SAME LAND, BROADBALK FIELD.

TABLE XXI.—Showing the PRODUCE of the WORST SEASON, 1879, the PRODUCE of the BEST SEASON, 1863, and the AVERAGE of 32 YEARS, 1852–1883.

Plot Nos.	Description of Manures. Quantities per Acre.	Best Season, 1863.	Worst Season, 1879.	Differ-ence.	Average 32 Years, 1852–'83.
	DRESSED GRAIN, PER ACRE—BUSHELS.				
3	Unmanured	$17\frac{1}{4}$	$4\frac{3}{4}$	$12\frac{1}{2}$	$13\frac{1}{8}$
2	Farmyard-manure	44	16	28	$33\frac{1}{2}$
5	Mixed mineral manure alone	$19\frac{5}{8}$	$5\frac{5}{8}$	14	$15\frac{1}{4}$
6	Mix. min. man. & 200 lbs. am.-salts = 43 lbs. N.	$39\frac{5}{8}$	$10\frac{1}{2}$	$29\frac{1}{8}$	$24\frac{1}{8}$
7	Mix. min. man. & 400 lbs. am.-salts = 86 lbs. N.	$53\frac{5}{8}$	$16\frac{1}{4}$	$37\frac{3}{8}$	$32\frac{3}{4}$
9	Mix. min. man. & 550 lbs. nitr.-soda = 86 lbs. N.	$55\frac{5}{8}$	22	$33\frac{5}{8}$	$36\frac{1}{4}$
8	Mix. min. man. & 600 lbs. am.-salts = 129 lbs. N.	$55\frac{3}{4}$	$20\frac{5}{8}$	$35\frac{1}{8}$	$36\frac{1}{4}$
	WEIGHT PER BUSHEL OF DRESSED GRAIN—LBS.				
3	Unmanured	62·7	52·5	10·2	58·8
2	Farmyard-manure	63·1	56·8	6·3	60·0
5	Mixed mineral manure alone	63·0	53·5	9·5	58·7
6	Mix. min. man. & 200 lbs. am.-salts = 43 lbs. N.	62·3	56·5	5·8	59·5
7	Mix. min. man. & 400 lbs. am.-salts = 86 lbs. N.	62·5	56·7	5·8	59·5
9	Mix. min. man. & 550 lbs. nitr.-soda = 86 lbs. N.	62·1	56·5	5·6	58·7
8	Mix. min. man. & 600 lbs. am.-salts = 129 lbs. N.	62·3	56·5	5·8	59·2
	STRAW (AND CHAFF) PER ACRE—LBS.				
3	Unmanured	1600	763	837	1272
2	Farmyard-manure	4279	2239	2040	3570
5	Mixed mineral manure alone	1728	855	873	1464
6	Mix. min. man. & 200 lbs. am.-salts = 43 lbs. N.	3715	1592	2123	2512
7	Mix. min. man. & 400 lbs. am.-salts = 86 lbs. N.	5866	3012	2854	3771
9	Mix. min. man. & 550 lbs. nitr.-soda = 86 lbs. N.	6312	4347	1965	4688
8	Mix. min. man. & 600 lbs. am.-salts = 129 lbs. N.	6602	4176	2426	4532
	TOTAL PRODUCE (GRAIN AND STRAW) PER ACRE—LBS.				
3	Unmanured	2,727	1093	1634	2090
2	Farmyard-manure	7,165	3303	3862	5689
5	Mixed mineral manure alone	3,017	1238	1779	2421
6	Mix. min. man. & 200 lbs. am.-salts = 43 lbs. N.	6,243	2283	3960	4029
7	Mix. min. man. & 400 lbs. am.-salts = 86 lbs. N.	9,358	4063	5295	5845
9	Mix. min. man. & 550 lbs. nitr.-soda = 86 lbs. N.	9,888	5809	4079	6982
8	Mix. min. man. & 600 lbs. am.-salts = 129 lbs. N.	10,216	5527	4689	6832

In the year 1863, the produce of the unmanured land was $17\frac{1}{4}$ bushels; and in the worst year, 1879, it was $4\frac{3}{4}$ bushels. As previous to the year 1863, 19 unmanured crops had been already taken, the produce obtained was not the largest which had been grown; and it is quite probable that had the season of 1863 occurred at the beginning of the period, the yield would have been considerably over 20 bushels. As it was, the yield of 1863 was equal to the average of the first 8 years.

In 1879 the yield was, as we have mentioned, only $4\frac{3}{4}$ bushels per acre, with a weight of $52\frac{1}{2}$ lbs. per bushel, or about one one-third of the average produce of the plot during the whole period of 40 years. The produce of the land receiving 14 tons of dung every year was, in 1863, 44 bushels, and in 1879 16 bushels per acre; a difference of 28 bushels per acre between the best and worst seasons.

Contrary to what might be expected, the produce on the land receiving dung, while it falls greatly in yield in a bad season, does not rise as rapidly in yield in a very favourable season. This will be seen more clearly by a comparison with the land which receives artificial manures. We find that plot 7, receiving mineral manures and salts of ammonia, gave in 1879 a crop exactly the same as that of the dung—16 bushels per acre; and we also find that the average produce of the 32 years is almost identical in both cases, one being $32\frac{3}{4}$ bushels, and the other 33 bushels per acre. But in the favourable season of 1863, we find that while the dung gave only 44 bushels per acre, the artificial manures gave a produce of $53\frac{5}{8}$, an excess of nearly 10 bushels per acre.

It is evident, therefore, that, under the most favourable climatic circumstances, the artificial manure is competent to give a much larger crop, both of corn and straw, than the dung.

In the same year (1863), plot 9, which received an equivalent amount of nitrogen in the form of nitrate of soda to that supplied in the salts of ammonia on plot 7, gave a slightly higher produce, the yield amounting to $55\frac{1}{2}$ bushels per acre; and taking the whole produce (corn and straw), this plot gives more than one ton per acre of total produce in excess of the yield on the dung plot.

To sum up, therefore, we find that under the best artificial manures, $35\frac{1}{8}$ more bushels per acre of wheat, and nearly 2 tons per acre more gross produce, were grown in the most favourable season, as compared with the produce grown in the worst season.

The Permanently Unmanured Plot.

The last time this land received any manure was in 1839. The crop, which was then turnips, was followed by barley,

peas, wheat, and oats, the last four crops being grown without any manure whatever. In the event of a failure of the clover-crop, such a course would not at the period have been unusual in the district, although in those days a top-dressing of soot would, in all probability, have been applied to the wheat. In this case, however, it was not applied; and, even if it had been applied, the land after the oat-crop would be considered, agriculturally speaking, to be exhausted.

It was at this period that the Rothamsted experiments were commenced, for the purpose of ascertaining what amount of crop the land would yield in wheat, without the aid of manure. The cultivation has been throughout of the most simple description, and no attempt has been made to increase the crop by deep, or subsoil ploughing. The land has, however, been kept free from weeds.

In the following table will be found a summary of the results given in 4 periods of 10 years each:—

Table XXII.—Showing the Number of Bushels of Dressed Corn per Acre, the Weight per Bushel, and Total Produce of Corn and Straw of the Permanently Unmanured Land, in Average Periods of Ten Years.

	Bushels of Dressed Corn per Acre.	Weight per Bushel.	Total Produce Corn and Straw in lbs.
Mean of 10 years, 1844–1853	15¾	58·25	2711
Mean of 10 years, 1854–1863	16½	57·57	2728
Mean of 10 years, 1864–1873	12¾	58·97	1924
Mean of 10 years, 1874–1883	10¼	58·25	1614
Mean of 40 years	14	58·26	2244

We have already noticed the number of fine wheat seasons which occurred during the second 10 years of the experiment, and we may further mention that the effect of these favourable seasons was sufficient to make the yield of grain of the second 10 years of unmanured wheat slightly higher than that of the first period, the average of the dressed corn per acre in the first period being 15¾, and in the second period 16½ bushels per acre. The total produce (corn and straw), which is a much more accurate measure of the available fertility of a soil than the grain alone, shows a considerable reduction in the second period as compared with the first.

In the third period of 10 years, the average decline is very decided, the mean for the 10 years being not quite 13 bushels

per acre, or nearly 4 bushels below the produce of the previous 10 years. In the fourth period of 10 years, the average produce was only $10\frac{1}{4}$ bushels per acre.

It is well known to all those connected with the land in Great Britain that the seasons have latterly been most unfavourable for the growth of wheat. It is therefore evident that the produce of the last 10 years does not correctly represent the reduction due to exhaustion of the soil alone. This, indeed, is proved by the fact that, under the influence of a rather better season, the produce of the last crop in 1883 was $13\frac{3}{4}$ bushels per acre, which very nearly represents the average yield of the 40 crops.

In our paper on "Home Produce, Imports, and Consumption," we made some attempts to calculate what was the annual decline in the produce due to exhaustion—irrespective of variations due to good or bad seasons—and it would appear probable that, up to a certain period, the decline might amount to about $\frac{1}{4}$ of a bushel per acre per annum—equal to a gross produce in corn and straw of 40 lbs. per acre.

It is evident, however, that with each decline the reduction will become less and less. Atmospheric influences, and even the small amount of ammonia brought down in the rain, will form a larger factor upon a declining crop. It is evident, therefore, that the actual process of the exhaustion of the soil differs considerably from all the preconceived ideas upon the subject. The soil, in fact, not only contains more fertility, but also holds it with a much firmer grasp, and parts with it less readily than we had previously imagined.

The average amount of produce in straw and corn removed has been 1 ton per acre, containing about 2000 lbs. of absolutely dry matter; and we have very strong evidence, derived from other experiments in the field, to prove that carbon and organic matter, generally, are derived from the atmosphere, while nitrogen and mineral matters are taken from the soil. This would divide the products into from 94 to 95 per cent. atmospheric, and from 5 to 6 per cent. soil compounds.

The average amount of soil compounds annually removed by this unmanured wheat crop is from 100 lbs. to 120 lbs. per acre; and of the three most important constituents of plant growth there have been removed 17 lbs. of potash, 10 lbs. of phosphoric acid, and 20 lbs. of nitrogen. Such are the results obtained up to the present time, and they may be summed up as follows:—Upon a field which has been under arable cultivation certainly for two or three centuries—and possibly for a much longer period—and which has consequently lost a very considerable amount of its original fertility, we find—after the removal of 40 unmanured

crops—a yield which differs very little from the average of some of the great wheat-growing countries of the world: the yield of the United States, India, and China being, it is stated, from 12 to 13 bushels per acre.

Now the Rothamsted soil certainly contains a very much less stock of fertility than the soils upon which wheat is grown in other countries; it is therefore impossible to attribute the comparatively large yield in our experimental crops to any other cause than to the clean state of the land. The amount of food at the disposal of the plant is small, but it is not shared to any great extent with other plants.

By way of illustration of what may occur where the land is not kept clean, we may mention that last autumn a portion of the crop at the top of our wheat field was left standing and allowed to shed its seeds, the soil not being disturbed in any way. About 14 bushels per acre fell upon the land, and up to a certain period the self-sown wheat was fairly plentiful. By this time, however,—less than one year—the weeds have almost destroyed the crop; and if the seed is left to sow itself again, it is very probable that every plant will be driven out before next summer.

The large produce of both wheat and barley upon the unmanured land in the Woburn experiments, also shows how much the crops grown upon the ordinary cultivated land of the country are reduced by weeds. It is true that weeds do not exhaust a soil, as, in their decay, the fertility which they have taken up becomes again available; but they take up nitric acid, which, during their growth, reverts to the form of organic nitrogen.

When this occurs in regard to the soil-nitrogen it is merely so much nitric acid employed in growing weeds instead of wheat; but when such active nitrogen as salts of ammonia, or nitrate of soda has been applied to the land, the loss is much more serious. A high price is paid for these substances, in consequence of the nitrogen they contain being in a very active form, competent to produce crop growth; whereas if weed growth takes place instead, the purchased nitrogen does not become available as food for the crop until the weeds decay.

Mineral Manures without Ammonia.

In our previous paper on the Growth of Wheat we were only able to give the produce of this plot for 12 years, as during the first 8 years of the experiment manures containing ammonia had been used in considerable quantities. We are now able to give the produce of this plot for 32 years, during which period a liberal supply of all the necessary mineral food of the wheat

crop has been placed upon the land every year, while for its nitrogen the crop has been left dependent upon the supplies furnished by the soil and atmosphere.

In the following table will be seen the produce of this plot for 4 periods of 8 years each: and, for comparison, there is also given the produce of the permanently unmanured crop over a similar period.

TABLE XXII.—Showing the PRODUCE of DRESSED GRAIN, and TOTAL PRODUCE (CORN and STRAW) upon PLOT 3 (the PERMANENTLY UNMANURED PLOT), and PLOT 5, which has received MIXED MINERALS for a period of 32 YEARS, divided into 4 periods of 8 YEARS.

	Without Manure, 3. Dressed Corn.	Mixed Minerals, 5 Dressed Corn.	Without Manure, 3. Total Produce Corn and Straw.	Mixed Minerals, 5. Total Produce Corn and Straw.
	bushels.	bushels.	lbs.	lbs.
8 years, 1852–1859	$16\frac{1}{8}$	19	2736	3191
8 years, 1860–1867	$13\frac{1}{2}$	$15\frac{1}{4}$	2183	2450
8 years, 1868–1875	$12\frac{1}{4}$	14	1833	2144
8 years, 1876–1883	$10\frac{1}{2}$	$12\frac{5}{8}$	1610	1895
32 years, 1852–1883	$13\frac{1}{8}$	$15\frac{1}{4}$	2090	2421
40 years, 1844–1883	14	..	2244	..

During the first 8 years of the experiment plot 5 received salts of ammonia, as well as mineral manures, and the average produce of wheat during these first 8 seasons was 29 bushels per acre, or 12 bushels annually in excess of the produce in the unmanured plot; while during the first 8 years of the mixed minerals, without the salts of ammonia, the average produce has been 19 bushels per acre, or nearly 3 bushels more than the permanently unmanured produce.

In the second period of 8 years the produce of the mixed minerals' plot has amounted to $15\frac{1}{4}$ bushels per acre, as against $13\frac{1}{2}$ bushels grown by the unmanured plot, a difference of $1\frac{3}{4}$ bushels in favour of the mixed minerals' plot. In the third period of 8 years, the produce of plot 5 was 14 bushels per acre: and in the last period of 8 years, it was $12\frac{5}{8}$, or rather more than $12\frac{1}{2}$ bushels per acre.

The whole period of 32 years has thus given an average of $15\frac{1}{4}$ bushels on the mixed minerals' plot, as against $13\frac{1}{8}$ bushels upon the permanently unmanured plot; and if we take the average produce of the unmanured plot for 40 years, the yield has been 14 bushels per acre. The application, therefore, of a

very liberal supply of minerals has only been competent to increase the yield by $1\frac{1}{4}$ bushels per acre per annum!

The average of the total produce—straw and corn—of the mixed minerals' plot for the 32 years, has amounted to 2421 lbs., and of the unmanured plot to 2090 lbs., a difference of 331 lbs. in favour of the minerals. The amount of nitrogen in this 331 lbs. would be not more than 3 lbs.; this represents the whole of the nitrogen which the wheat upon an acre of land—though furnished with an abundance of minerals—has been able to obtain from the soil and atmosphere in excess of that obtained by the wheat grown without manure!

In order to explain the causes which have produced these crops, it will be necessary to show what has taken place in the soil; but before doing so, it may be as well to give a slight review of the crops themselves.

We find the two crops running a parallel course, showing great differences in their yield as the seasons are favourable or unfavourable, but rarely differing from each other more than from 3 to 4 bushels per acre. The yield in both is slowly declining, as we find that during the first 8 years the unmanured produce gave, in two separate years, a crop of 20 bushels per acre; and the mineral-manured plot on three occasions yielded a crop exceeding 20 bushels per acre. For the last 23 years, neither plot has given a produce of 20 bushels, and it is hardly possible that, without some change in the manures applied, a crop of this size can ever be grown again.

The Rothamsted soil—like a great many cultivated soils—contains a large amount of the mineral food of plants; it also contains organic nitrogen, that is to say, nitrogen in combination with carbon, the residue of previous vegetation. This organic nitrogen does not appear to be available as food for the wheat plant, but every year a certain amount of it is converted into nitric acid, which combines with the lime in the soil. In this state it is very soluble in water, is readily washed out of the soil by heavy rain, and, further, is a most important and essential food of the wheat plant.

The amount of nitric acid formed each year will vary, the formation being most rapid in the hottest weather, provided the soil is sufficiently moist. The amount of nitric acid which the wheat crop can take up will also vary, and in a cold and wet winter much will be washed beyond the reach of the roots of the plant.

These facts, which are of universal application, enable us to explain some of the causes which tend to the production of good or bad crops of wheat. Analyses of the soil of these two

plots, made at different times, show that both have lost a large amount of organic nitrogen; and that, in the first 9 inches from the surface, the mineral-manured soil has lost rather the most.

The total loss of nitrogen in the soil is larger than the amount of this substance which has been removed in the crops, and the reason for this will be found in an examination of the drainage-water. Except when the crop is in full vigour of growth, the drainage-water contains nitric acid. In our paper on Rain and Drainage, published in this Journal, we have gone so fully into this question that it will be sufficient here to say that of the 28 lbs. to 32 lbs. of nitrogen (as nitric acid) per acre, which is at the disposal of the crop each year, we estimated that about $\frac{2}{3}$ are taken up by the crop, and that $\frac{1}{3}$ goes into the drains and is lost.

There was rather more nitric acid formed in the soils which received minerals, and in consequence the crop was slightly increased; but the evidence is distinct and conclusive as regards the very small effect which followed the large applications of mineral matter.

On the unmanured soil the minerals at the disposal of the crop were quite sufficient to utilise the whole of the nitric acid liberated; and in fact the results obtained on plot 10A prove conclusively that the available minerals were competent to grow a much larger crop than that actually produced; further, as very little more nitric acid was liberated upon the mineral soil—and the crop was unable to obtain nitrogen from the atmosphere—we have as the result a produce very slightly in excess of that grown on the permanently unmanured land.

By means of these experiments we more readily arrive at an explanation of the fact that on some soils—more especially the newly cultivated soils of the United States—a large increase in the wheat crop frequently follows the application of mineral manures. Soils rich in organic matter may yield an increased amount of nitric acid by the application of phosphates and potash, but in all cases the source of the nitrogen is the soil, and the loss in these experiments of about 1000 lbs. of soil nitrogen per acre is a fact of the greatest importance.

Ammonia without Minerals. Plots 10 A, B, and 17, 18.

The recent legislative enactments, giving the cultivator of the soil a claim for the manure ingredients possessing a pecuniary value, which he has applied to the land, add greatly to the interest of all investigations which have a bearing upon this important subject.

In plots 10 A and 10 B, we have two parallel experiments. In 1844 both received an application of mineral manures, and produced a crop yielding $15\frac{1}{2}$ bushels of wheat per acre. In 1845, both received a dressing of salts of ammonia, which yielded a crop of 32 bushels per acre.

From that time they have been treated as two separate experiments; 10 A, from 1846 to the present time—a period of 38 years—has received annually a dressing of salts of ammonia: while in 1846, 10 B was unmanured. In 1848, 10 B received a dressing of minerals, and the same amount of salts of ammonia as 10 A. In 1849, it received salts of ammonia alone, and in 1850, minerals alone.

The difference between the two plots has therefore been as follows: 10 A has received one dressing of minerals, followed by 39 dressings of salts of ammonia: 10 B has received three dressings of minerals during the 7 years; and for the last 33 years both plots have been manured exactly alike, receiving salts of ammonia every year.

In the following table will be seen (1) the produce of each plot separately during the first 8 years: (2) the mean produce of the two plots during each 8 years: (3) the mean of 32 crops.

TABLE XXIV.—Showing the PRODUCE of 10 A and 10 B for each of the FIRST 8 YEARS of the EXPERIMENT, and afterwards the AVERAGE PRODUCE in PERIODS of 8 YEARS; 10 A receiving MINERAL MANURE in 1844, and for the last 39 YEARS SALTS of AMMONIA; 10 B receiving MINERALS alone in 1844 and 1850, being unmanured in 1846, and receiving MINERALS with SALTS of AMMONIA in 1848. For the last 32 YEARS 10 B has received the SAME MANURE as 10 A.

	10A. Dressed Corn.	10B. Dressed Corn.	10A. Total Produce Corn and Straw.	10B. Total Produce Corn and Straw.
	bushels.	bushels.	lbs.	lbs.
1844	$15\frac{1}{2}$	$15\frac{1}{2}$	2120	2120
1845	$31\frac{7}{8}$	$31\frac{7}{8}$	6246	6246
1846	$27\frac{3}{8}$	$17\frac{5}{8}$	4094	2671
1847	$25\frac{3}{4}$	$25\frac{3}{4}$	4593	4579
1848	$19\frac{1}{4}$	$25\frac{1}{8}$	3701	4530
1849	$32\frac{5}{8}$	$32\frac{3}{8}$	4992	5117
1850	27	18	4810	3120
1851	$28\frac{7}{8}$	$28\frac{5}{8}$	5036	4985
8 years, 1852–1859	$22\frac{3}{4}$	$27\frac{1}{2}$	4055	4885
8 years, 1860–1867	24	$27\frac{1}{4}$	4076	4563
8 years, 1868–1875	19	$20\frac{1}{8}$	3060	3264
8 years, 1876–1883	$16\frac{3}{8}$	$18\frac{1}{8}$	2618	2935
32 years, 1852–1883	$20\frac{1}{2}$	$23\frac{1}{4}$	3452	3912

It will be observed that in 1848, when 10 B received mineral manures as well as salts of ammonia, the produce was 25⅛ bushels per acre, as against 19¼ bushels per acre on plot 10 A, which received the same salts of ammonia without minerals. On the other hand, when 10 B, in 1850, received minerals alone, the produce was only 18 bushels per acre as against 27 bushels obtained on 10 A, which was manured with salts of ammonia only.

Turning now to the period of 8 years each, it will be seen that in every case the produce of 10 B was larger than that of 10 A; the difference is however a declining one, being in the first 8 years not quite 5 bushels per acre per annum, in the last 5 years 1½ bushels per acre, and over the whole period not quite 3 bushels per acre per annum.

It is well known that the drainage-water that comes from cultivated fields contains but a very small amount of potash, and frequently no phosphoric acid; we have no difficulty, therefore, in tracing the increased produce obtained by 10 B over 10 A to the minerals applied to the former in 1848 and 1850.

The potash and phosphoric acid applied to both 10 A and 10 B must have been removed in the crops many years ago, but the much greater amount which 10 B received in the earlier years of the experiment must have caused the resources of the soil to be more largely drawn upon by the crops upon plot 10 A, than by those upon plot 10 B.

These large applications of potash and phosphoric acid—although applied in the form of soluble compounds—appear to enter into very fixed combinations, somewhat similar to those already existing in the soil; and in this respect they differ altogether from compounds of ammonia and nitric acid, as the latter appear to be either destroyed or washed away, unless they are fixed in vegetation, while the former are fixed by the soil itself, and are only taken out of it by means of vegetation.

Plots 17 and 18.

In the last experiment it was shown that potash and phosphoric acid were producing an influence upon the wheat crop 33 years after their application.

In the experiment to which we are now about to refer we have to trace the unexhausted residue of another substance perfectly soluble in water. On plots 17 and 18 the mineral manures and the salts of ammonia are never used together. When plot 17 receives minerals, plot 18 receives salts of ammonia; and when plot 18 receives minerals, plot 17 receives salts of ammonia. During the 32 years of the experiment each plot

has received 16 applications of mineral manures, and 16 applications of salts of ammonia.

It is evident that an experiment of this description is well adapted to ascertain the unexhausted residue of a substance like salts of ammonia. During the first 8 years the two plots received different artificial manures, yielding a very similar produce. In the following table will be found the average produce of the mineral manures, and also of the salts of ammonia in periods of 8 years; further, for comparison, is given the average produce of plot 5, where minerals alone have been employed.

TABLE XXV.—Showing the BUSHELS of DRESSED GRAIN and TOTAL PRODUCE (CORN and STRAW) upon PLOTS 5, 17, and 18; 5 being MANURED with MIXED MINERAL MANURES alone during the whole PERIOD, and 17 and 18 receiving alternately MINERALS and SALTS of AMMONIA.

	Plot **5**, Mineral Manures every Year. Bushels per Acre Dressed Corn.	Plots **17** or **18**, Mineral Manures only. Bushels per Acre Dressed Corn.	Plots **17** or **18**, Salts of Ammonia only. Bushels per Acre Dressed Corn.	Plot **5**. Total Produce Corn and Straw.	Plots **17** or **18**. Minerals only. Total Produce Corn and Straw.	Plots **17** or **18**. Ammonia only. Total Produce Corn and Straw.
8 years, 1852–1859 ..	19	$18\frac{7}{8}$	$32\frac{3}{8}$	3191	3235	5938
8 years, 1860–1867 ..	$15\frac{1}{4}$	$16\frac{1}{2}$	$31\frac{1}{4}$	2450	2696	5297
8 years, 1868–1875 ..	14	15	$28\frac{1}{2}$	2144	2404	4781
8 years, 1876–1883 ..	$12\frac{5}{8}$	$12\frac{1}{4}$	$27\frac{3}{4}$	1899	1869	4930
32 years, 1852–1863 ..	$15\frac{1}{4}$	$15\frac{5}{8}$	30	2421	2551	5237

Looking at the bottom line—which gives the average of the whole period of 32 years—it will be seen that during the 16 seasons in which plot 17 received salts of ammonia, and in the 16 seasons in which plot 18 received that substance, the average produce was 30 bushels per acre; while the plot which during the alternate years received minerals only, yielded $15\frac{5}{8}$ bushels; or in other words, only a fraction of a bushel more than plot 5, which had received no ammonia during the whole period!

In the 400 lbs. of salts of ammonia it is estimated that 86 lbs. of nitrogen are applied to an acre.

The resources of the soil were evidently competent to furnish the nitrogen contained in 15 bushels of wheat, and its straw, as we obtained that produce on plot 5 which receives no ammonia. In the remaining 15 bushels and its straw, obtained by the application of the salts of ammonia, certainly less than 26 lbs.

of nitrogen have been carried off, thus leaving 60 lbs. of nitrogen to be accounted for!

In the autumn of 1881, the soil in the various experimental plots was sampled and analysed, both for the total nitrogen and for nitric acid, to the depth of 27 inches. Although the soil of plots 17 and 18 contained rather more total nitrogen and nitrates than plot 5, still—within the range examined—there was no evidence of the existence in the soil of the large amount of nitrogen supplied in the manure, and not accounted for in the crop.

It is quite certain, therefore, that when salts of ammonia are applied to grow wheat, it is not safe to calculate upon any of the unexhausted residue being available for the purpose of growing a second corn-crop.

There is also evidence to show that the exhausting character which practical farmers attribute to corn crops, is quite as much due to the nitrogen which they do not assimilate being washed out of the soil, as it is to the amount of that substance which is removed in the produce.

Mixed Minerals with Salts of Ammonia and Nitrate of Soda.

Having already given the result of experiments on which mixed minerals were used alone, as also where salts of ammonia were used alone, we now come to another series of experiments, where one uniform quantity of mixed minerals was used in each case, but with different amounts of nitrogen in the form of salts of ammonia, and also as nitrate of soda. The applications were as follows:—Plot 6 A and B received 200 lbs. of sulphate and muriate of ammonia, containing 43 lbs. of nitrogen; plot 7 A and B, 400 lbs. of the same salts, containing 86 lbs. of nitrogen; and plot 8 A and B, 600 lbs. of the same salts, containing 129 lbs. of nitrogen; while plot 9 A, received 86 lbs. of nitrogen as nitrate of soda, instead of salts of ammonia.

For the first twelve years of the experiment, we further employed on plot 16 A and B, 800 lbs. of salts of ammonia, containing 172 lbs. of nitrogen; but even in 1863—a season which for productiveness is not likely to be repeated except at rare intervals—the 800 lbs. produced so small an increase over the manure containing 600 lbs. of ammonia, that it was decided to stop the application, with the view of obtaining, by this means, some information in regard to the unexhausted residue of manures.

In the following table is given—in 4 periods of 8 years each—the produce of wheat grown by the minerals and nitrogen in various proportions for 32 years in succession; and for com-

parison the produce over the same period, obtained by the mineral manure alone.

TABLE XXVI.—Showing the PRODUCE of WHEAT GRAIN, in BUSHELS per ACRE, and TOTAL PRODUCE (CORN and STRAW) grown by MIXED MINERALS alone, and with SALTS of AMMONIA, and NITRATE of SODA during 32 YEARS, in periods of 8 YEARS.

DRESSED CORN PER ACRE IN BUSHELS.

	Mixed Minerals alone.	With Salts of Ammonia.			With Nitrate of Soda.
		43 lbs. Nitrogen.	86 lbs. Nitrogen.	129 lbs. Nitrogen.	86 lbs. Nitrogen.
8 years, 1852–1859	19	$27\frac{7}{8}$	$35\frac{1}{2}$	$36\frac{7}{8}$	$31\frac{1}{8}$
8 years, 1860–1867	$15\frac{1}{4}$	$26\frac{1}{4}$	$36\frac{1}{4}$	$39\frac{3}{4}$	$40\frac{1}{4}$
8 years, 1868–1875	14	22	31	36	39
8 years, 1876–1883	$12\frac{5}{8}$	$20\frac{3}{8}$	28	$32\frac{1}{4}$	$34\frac{3}{4}$
32 years, 1852–1883	$15\frac{1}{4}$	$24\frac{1}{8}$	$32\frac{3}{4}$	$36\frac{1}{4}$	$36\frac{1}{4}$

TOTAL PRODUCE PER ACRE IN CORN AND STRAW.

	Mixed Minerals alone.	With Salts of Ammonia.			With Nitrate of Soda.
		43 lbs. Nitrogen.	86 lbs. Nitrogen.	129 lbs. Nitrogen.	86 lbs. Nitrogen.
8 years, 1852–1859	3191	4808	6490	7012	5897
8 years, 1860–1867	2450	4276	6262	7363	7862
8 years, 1868–1875	2144	3612	5379	6593	7344
8 years, 1876–1883	1899	3422	5248	6361	6824
32 years, 1852–1883	2421	4029	5845	6832	6982

Taking the three proportions of nitrogen, as applied in salts of ammonia, it will be seen that in the separate periods of 8 years each, and also in the whole period of 32 years, the increase of wheat obtained by the addition of 43 lbs. of nitrogen to the minerals, varies from 8 to 11 bushels per acre; the total increase over the whole period being not quite 9 bushels per acre. The application of an additional 43 lbs. of nitrogen, or in other words, a total application of 86 lbs. of nitrogen, again

increases the amount of wheat by between 8 and 9 bushels over the whole period; the minerals alone yielding 15¼ bushels, the 43 lbs. of nitrogen 24⅛ bushels, and the 86 lbs. of nitrogen, 32¾ bushels per acre.

Comparing the four periods of 8 years with each other, it will be seen that the minerals alone, during the last period of 8 years gave 6½ bushels per acre less than during the first period; while the 43 lbs. of nitrogen yielded between 7 and 8 bushels per acre, and the 86 lbs. of nitrogen yielded 7½ bushels per acre less than during the first period. The reduction therefore would appear to be due to some cause which equally affected the three crops.

The addition of another 43 lbs. of nitrogen, by the application of 129 lbs. of the substance, proved far less effective than the previous additions, as instead of being from 8 to 9 bushels, the increase was only 3½ bushels per acre; the average of the whole period of 32 years being, for the highest manure—where the 129 lbs. of ammonia was applied—36¼ bushels per acre, and where 86 lbs. of nitrogen was applied, 32¾ bushels per acre.

The total increase obtained by this large amount of nitrogen —in excess of the produce obtained by the mineral manures alone—amounted only to 21 bushels per acre per annum; it is therefore quite evident that in this experiment the nitrogen applied was in excess of the quantity which could be utilised by the crop; and even in the best season of growth, 1863, when the crop which received 86 lbs. of nitrogen yielded 53½ bushels per acre, the crop receiving 129 lbs. only yielded 2 bushels more!

The average yield of wheat in Great Britain is estimated by us at 28 bushels, and by others at 30 bushels per acre. The crop obtained by 86 lbs. of nitrogen appears to have quite reached, if it has not exceeded the profitable limit of growth; and it is only a rise in the price of wheat—and not lower prices—that could justify the outlay in manure which would be required to grow a larger crop. We have abundant evidence that a considerable amount of the nitrogen of the salts of ammonia has been converted into nitric acid during the autumn and washed into the drains during the winter. At the time of the application of the nitrate of soda in the spring, the plots receiving the ammonia had lost more or less nitrogen, and until 1877 the relative crop-producing power of nitrogen as ammonia, and as nitric acid in the form of nitrate of soda, was not carried out on equal terms. Since 1877, plot 7 A and B has received its dressing of salts of ammonia in the spring, while we have

another plot, similarly manured, which receives these salts in the autumn; and although the spring-sown ammonia has given the largest produce, still, the difference between the two crops is by no means what we might have expected from the known loss by drainage which took place in the autumn-sown manure.

In the autumn of 1881 the soil of the various experimental plots was sampled to the depth of 27 inches. Between the application of the salts of ammonia in the spring and the time of sampling, only a small amount of drainage had taken place, but the nitric acid in the soil and drainage water did not account for the nitrogen which had been applied in the salts of ammonia, but had not been taken up by the crop, and it appears quite possible that a considerable destruction of ammonia may take place in a soil, which would be in a much drier state in the spring than during the autumn and winter.

It was not until after the experiment had been carried on for 8 years that the nitrate began to show a superiority over the salts of ammonia, as up to that period, in the case of every one of the crops the ammonia gave the largest yield, the excess amounting in 8 years to $4\frac{1}{2}$ bushels per acre. During the next 3 periods the nitrate was considerably in excess; and over the whole period of 32 years the nitrate gave an increase, over the salts of ammonia, of not quite 4 bushels per acre, the produce of the ammonia being $32\frac{3}{4}$ bushels, and that of the nitrate $36\frac{1}{4}$ bushels per acre.

The produce of the nitrate supplying 86 lbs. of nitrogen is exactly equal to that of the salts of ammonia supplying 129 lbs. of this substance, both giving $36\frac{1}{4}$ bushels per acre; and if we take the total crop grown by the two salts—which is by far the best measure of the power of a manure to produce growth—we find that the 86 lbs. of nitrogen as nitrate of soda produced 6982 lbs., and the 129 lbs. of nitrogen in salts of ammonia 6832 lbs. of total produce per acre.

Although there is often a strong prejudice against the use of nitrate of soda, it is evident from this example that, when judiciously applied, its properties as a manure are much higher than those of salts of ammonia. We may add, that when used continuously for 32 years its power to produce growth appears to increase, rather than to diminish, as during the last 16 years the total produce per acre of 9 A, in excess of the produce of 7 A—each receiving equal amounts of nitrogen—has been 7084 lbs. as against 5313 lbs.; a difference of 1771 lbs. of total produce per acre per annum in favour of the nitrate.

PLOTS 16 A and B.

The Unexhausted Residue of Manures.

From 1852 to 1864, inclusive, these two plots received a mixed mineral manure and 800 lbs. of salts of ammonia, an amount which furnished to the crop annually 172 lbs. of nitrogen. It is very rarely that a sufficiently large crop of wheat is grown to remove one-half of this quantity of nitrogen.

In 1863 and 1864 the seasons were highly favourable for the growth of wheat; and as the size of the crop is regulated very much by the amount of nitrogen at its disposal, the two seasons were well adapted for ascertaining how much of this very large application could be employed in the growth of the crop.

In 1863 the yield of plot 16 was 56 bushels per acre, and in 1864, 51 bushels per acre. But plots 8 A and B produced respectively 56 bushels and 50 bushels in the same years, by means of an application of 600 lbs. of ammonia; and as the additional 200 lbs. only added 1 bushel to the crop, it was quite evident that we had reached the possible limits of growth, even in seasons so favorable. It did not indeed seem likely—and the result afterwards confirmed the view—that such favourable seasons would occur again in a period of 20 years. Under these circumstances we therefore decided to stop all further manuring after 1864, with the view of obtaining information, which might prove to be very valuable, in regard to the unexhausted residue of the manure employed.

The following table (p. 440) gives the produce of plot 16 for 2 years during which it received manure; and for 19 years during which it was unmanured: also for comparison is given the produce of plot 5, which received an annual dressing of minerals.

It will be seen that the first year after the manures were stopped, the produce of plot 16 was 32 bushels, or 18 bushels in excess of that grown on plot 5. In the next year, plot 16 gave $17\frac{1}{4}$ bushels, and plot 5 gave 13 bushels, a difference of only 4 bushels in favour of plot 16. In the two years that succeeded, plot 16 yielded 5 bushels in excess of plot 5 for each year; but in the years that followed them, the produce on the two plots was almost identical, in fact, the total produce of straw and corn on plot 16 was 6 lbs. per acre less than the total produce on plot 5. During the next 6 years, however, the total produce of plot 16 exceeded that of plot 5 to the extent of from 116 lbs. to 221 lbs. each year; it was, therefore, not until 12 years after the last application, that all influence due to previous manuring ceased.

TABLE XXVII.—Showing the PRODUCE of the last Two CROPS on PLOT 16, which received for 13 YEARS in succession an ANNUAL DRESSING of MIXED MINERALS, and SALTS of AMMONIA containing 172 lbs. of NITROGEN; followed by 19 UNMANURED CROPS. And for comparison, the produce of PLOT 5, which received MINERAL MANURES only over the whole period.

	Plot **5**. Minerals Alone.	Plot **16**. Minerals and 172 lbs. Nitrogen.	Plots **5**. Minerals Alone.	Plot **16**. Minerals and 172 lbs. Nitrogen.
	Dressed Corn in Bushels per Acre.		Total Produce in Corn and Straw.	
1863	$19\frac{5}{8}$	$55\frac{7}{8}$	3017	10,525
1864	$16\frac{7}{8}$	$51\frac{1}{8}$	2462	9,348
	Minerals	Unmanured	Minerals	Unmanured
1865	$14\frac{1}{4}$	$32\frac{3}{8}$	2091	5,007
1866	$13\frac{1}{4}$	$17\frac{3}{8}$	2303	3,081
1867	$9\frac{1}{4}$	$14\frac{5}{8}$	1613	2,512
1868	$17\frac{5}{8}$	$22\frac{3}{4}$	2481	3,503
1869	$15\frac{3}{4}$	$16\frac{1}{8}$	2543	2,647
1870	$18\frac{7}{8}$	$18\frac{1}{4}$	2564	2,557
1871	$11\frac{7}{8}$	$13\frac{1}{2}$	2207	2,380
1872	$12\frac{3}{4}$	$13\frac{1}{8}$	2166	2,387
1873	$12\frac{3}{4}$	$12\frac{3}{4}$	1806	1,921
1874	13	$11\frac{7}{8}$	1674	1,892
1875	$9\frac{1}{4}$	$10\frac{1}{8}$	1714	1,829
1876	$10\frac{1}{2}$	11	1429	1,538
1877	$11\frac{5}{8}$	$9\frac{7}{8}$	1570	1,340
1878	$14\frac{3}{4}$	$13\frac{3}{8}$	2222	2,181
1879	$5\frac{5}{8}$	$4\frac{7}{8}$	1238	1,154
1880	$17\frac{3}{4}$	$14\frac{5}{8}$	2818	2,383
1881	$12\frac{3}{4}$	$13\frac{1}{2}$	1709	1,736
1882	$12\frac{1}{2}$	$10\frac{3}{4}$	2057	1,925
1883	$15\frac{3}{4}$	$15\frac{7}{8}$	2147	2,131

With regard to the large crop grown during the first year after the manure was stopped, we are inclined to think it was mainly due to a certain portion of the salts of ammonia not having been washed out of the soil. The year of the last application, 1864, was one of exceptional drought; in fact, it was the driest year we have ever experienced at Rothamsted since the commencement of our experiments; and it is probably owing to this that a portion, at all events, of the produce was due. While the excess of produce obtained on plot 16, as compared with plot 5, during the next 10 years, is probably due to the slow decay and nitrification of the stubble, and underground roots of the very large crops grown on this plot for so many years.

During the 13 years of the application of 800 lbs. of salts of ammonia, considerably more than 1000 lbs. of the nitrogen applied to the soil has not been recovered in the crops; it is therefore hardly possible to suppose that the nitrogen contained

in the 6600 lbs. of total produce obtained, in excess of that grown on plot 5, during the next 10 years—which produce would not contain more than 60 lbs. of nitrogen—could have its source in the salts of ammonia as such, except so far as a portion of the first crop was concerned.

All the evidence, indeed, points to the residue of the crop itself as being the source of the unexhausted manure; and it is quite certain that the very large amount of roots possessing considerable fertilising influence, which some of our rotation crops leave in the ground, have much to do with their value as restorative crops. In 1865 samples of soil taken from the various experimental plots were submitted to analyses, and the percentage of nitrogen in the first 9 inches of soil on plot 16 was higher than on any other plot receiving artificial manures; while, in 1881—after 17 unmanured crops had been taken—when analyses of the soil were again made, it was found that the percentage of nitrogen was considerably reduced, and it was in fact not much higher than that on the unmanured plot.

Farmyard Manure.

From the commencement of the permanent wheat experiment, one plot has received annually 14 tons of ordinary farmyard-manure per acre. No attempt has been made to ascertain by means of chemical analysis the composition of the manure applied, for two reasons: (1) in the earlier years of the experiments, the importance of knowing the exact amount of the various ingredients applied to the soil was not well understood; (2) later on, the want of success in a very careful attempt to ascertain the exact composition of some box dung at Woburn, satisfied us that it was better to trust to a composition derived from a variety of analyses of farmyard-manure, than to give the composition derived from analyses in the accuracy of which we could feel no confidence.

The following table gives the estimated amount of some of the more important ingredients supplied to the soil annually in 14 tons of farmyard-manure, as also of the amount of ingredients supplied in artificial manure on plot 7:—

Table XXVIII.

	Dry organic Matter.	Nitrogen.	Phosphate of Lime.	Potash.
	lbs.	lbs.	lbs.	lbs.
Dung, Plot 2	7526	200	155	168
Artificial, Plot 7.. ..	..	86	140	100

Although the ingredients furnished to the soil in plot 7 differ greatly from those furnished by the dung, the produce of both crops resemble each other very closely, as will be seen in the following table:—

TABLE XXIX.—Showing the AMOUNT of WHEAT GRAIN, and TOTAL PRODUCE (CORN and STRAW) upon PLOT 2, MANURED with 14 TONS of FARMYARD-MANURE per ACRE per ANNUM; and PLOT 7, MANURED with MINERALS and SALTS of AMMONIA, in PERIODS of 8 YEARS.

	Farmyard-Manure. 14 tons.	Minerals and Salts of Ammonia. 86 lbs. Nitrogen.	Farmyard-Manure. 14 tons.	Minerals and Salts of Ammonia. 86 lbs. Nitrogen.
	Dressed Grain in Bushels per Acre.		Total Produce in Corn and Straw.	
8 years, 1852–1859 ..	$34\frac{3}{8}$	$35\frac{1}{2}$	6100	6490
8 years, 1860–1867 ..	$35\frac{3}{4}$	$36\frac{1}{4}$	5926	6262
8 years, 1868–1875 ..	$35\frac{1}{4}$	31	5932	5379
8 years, 1876–1883 ..	$28\frac{5}{8}$	28	4798	5248
32 years, 1852–1883 ..	$33\frac{1}{2}$	$32\frac{3}{4}$	5689	5845
40 years with farmyard dung	$32\frac{3}{8}$	..	5516	..

Taking the whole period of thirty-two years—during which the two experiments received the same manure each year—it will be seen that the difference in the produce of the two plots is less than one bushel per acre, the dung yielding an average produce of $33\frac{1}{2}$ bushels per acre, and the artificial manures one of $32\frac{3}{4}$ bushels per acre. While of the total produce, in corn and straw, the artificial manures on plot 7 give an increase over that on plot 2 of 156 lbs. per acre.

The most striking contrast between the two manures which give these very nearly identical results, is, that while the farmyard dung furnishes to the soil a large amount of organic matter, the artificial manure supplies none.

On plot 2, each year, about 8540 lbs. of organic matter were placed in the soil, of which not not more than one-half was recovered in the crop; and yet the artificial manures, which supplied no organic matter whatever, produced a crop which gave rather the larger amount of organic matter of the two: and we have further evidence to show that by merely increasing the amount of nitrogen, a still larger amount of organic matter can be obtained in the crop, as plot 8—which receives 129 lbs. of

nitrogen each year, a quantity much less than that supplied in the dung—gives, over a period of 32 years, a total produce in straw and corn of 6982 lbs. per acre, or 1200 lbs. more than that obtained on plot 2.

It is quite evident from these results, that the amount of organic matter in the crop bears no relation to that supplied in the manure; and that the atmosphere, and not the soil, is the source of this supply.

The farmyard-manure not only furnished a large amount of organic matter to the soil, but it also furnished a larger amount of nitrogen than the artificial manures on plot 7. To produce a crop equal to that grown by artificial manures on plot 7, we estimate that the farmyard-manure furnished the soil with more than twice the amount of nitrogen supplied by the artificial manures.

In the two years of 1863 and 1864, on plot 2—which was estimated to supply 400 lbs. of nitrogen—the total produce amounted to 13,653 lbs.; while that of plot 16—which furnished 144 lbs. of nitrogen in salts of ammonia—was 20,043 lbs., or in other words, more than 6000 lbs. excess of crop in two years!

As so much less growth can be obtained from the nitrogen in dung, than from that in salts of ammonia, or nitrate of soda, it is evident that the nitrogen in these substances must be in different chemical combinations.

In the soil, the nitrogen, which constitutes one of the most important elements in what we describe as permanent fertility, is always in combination with carbon. In this form it is both insoluble and inactive, and it only becomes an active food for vegetation when, by the process of nitrification, it ceases to be in combination with carbon.

In dung, by far the greater part of the nitrogen is in combination with carbon; and, when we consider the various substances which make up a mass of manure, we recognise at once that the individual periods of their decay, or nitrification, must vary greatly. The carbon may be separated from the nitrogen in urine in the course of a few weeks or months, while it may take many years to nitrify portions of the woody matter of straw, especially on heavy land.

We have mentioned that in consequence of the inactive condition of much of the nitrogen in dung, it requires a considerably larger application of that substance, to grow the same amount of crop as that produced by a much smaller application of nitrogen, in the more active form of ammonia and nitrates. This being the case, it is evident that in the soil where dung has been employed, we ought to find a larger amount both of carbon and

nitrogen, than in the soil where artificial manures have been used.

The evidence which we possess on this point is both interesting and instructive.

On the Underground Fertility of Plots 2, 3, *and* 7.

Although the nitrogen supplied to the land in the 14 tons of dung was considerably in excess of the amount supplied to plot 7 in the salts of ammonia, still the produce of the wheat on both plots was nearly the same; while the produce on plot 8 —which received a larger amount of salts of ammonia—was much higher than that on plot 2, although the nitrogen supplied was still considerably less than that contained in the farmyard-manure.

The great distinction between the two manures is, however, due to the nitrogen in the dung being chiefly in combination with carbon, and very little is yet known in regard to the various compounds of carbon existing in the soil.

In agriculture, we know that by the continual application of dung to the soil, as is the case in a garden, the soil increases in fertility, however much we may crop it. Some compounds of carbon and nitrogen are exceedingly durable, a familiar instance of which is to be found in coal; while in coke, nearly one-half of the nitrogen contained in the coal appears to be retained, although the latter has been exposed to a red heat. As regards dung, therefore—which is made up of urine, the indigestible portions of food, and straw—we might expect to find that the process of its decay and parting with its carbon would extend over very different periods of time.

The soil of the dunged plot has been sampled and analysed on four different occasions. These analyses form a portion of an immense series of soil analyses which have been made from time to time on the various experimental and other fields at Rothamsted.

Some of the analyses have been made upon subsoils taken to a depth of 9 feet from the surface, but the greater portion do not extend below 27 inches, each sample representing 9 inches of soil in depth.

The great advantage to be derived from taking a large number of analyses is, that we are thus enabled to form a better judgment in regard to the accuracy of each separate result. In the present instance, however, our object is rather to point out the circumstances under which fertility accumulates in the soil, than to attempt to measure its exact amount.

We estimate that within 27 inches from the surface, the

nitrogen on plot 2 will amount to, and possibly exceed 8000 lbs. per acre. This would exceed the amount, to the same depth, on plot 7 by more than 1600 lbs., and that contained on the permanently unmanured land (plot 3) by more than 2200 lbs.

By far the largest difference in the nitrogen of the three plots is found in the first 9 inches from the surface. At that depth the dunged land contained double the amount of nitrogen which is found on plot 3, and one and a half times as much as is found on plot 7; and we estimate that plot 3, after the removal of forty unmanured crops of wheat in succession, still contains about 2000 lbs. of nitrogen in the first 9 inches from the surface; this, in fact, represents the residue of the natural fertility, or, to use a word imported into the Agricultural Holdings Act, of the inherent capability of the soil.

The relation between the carbon and nitrogen in these three soils, which differ so greatly in their total amount of nitrogen, indicates that they do not differ much in their character. On the unmanured land the amount of carbon to 1 of nitrogen is not quite 10; on plot 7 it is 1 to $10\frac{1}{2}$; and on the land which receives dung it is not quite 1 to 12. Now the unmanured plot has received neither carbon nor nitrogen in manure; plot 7 has received a very large amount of nitrogen, but no carbon; while plot 2 has received a very large amount of both carbon and nitrogen. The relation between the carbon and nitrogen in the farmyard-manure is in the proportion of about 25 of carbon to 1 of nitrogen; this proportion is totally different to what we find it in the soil.

The close relation between the carbon and nitrogen in plot 3 and plot 7 indicates that the larger amount of nitrogen found in the soil of plot 7 is not due to the direct storing up of ammonia by the soil, but to the nitrogen forming part of vegetable growth, and being thus stored up in the stubble and roots.

If the nitrogen of the salts of ammonia had been stored up in any form except that of vegetable growth, the relation of carbon to nitrogen would have been lower on plot 7 than on plot 3, instead of which it is higher. There is also very clear evidence, derived from analyses of the soil of plot 3 and plot 7, that of the two the latter contains by far the larger amount of unexhausted fertility.

In the adjoining field, where barley is grown continuously, we have not only the evidence of the same accumulation having taken place as shown by analysis, but we have the evidence of the crops themselves. For twenty years in succession, 14 tons

of farmyard dung were applied to the barley crop, after which period the plot was divided into two; on one half the dung was continued as before, and upon the other half it was stopped. Up to the present time 12 unmanured crops have been taken, which yielded an average of 34½ bushels per acre, and, as the last crop in a rather favourable season exceeded 35 bushels, there is evidence of a long future before the fertility of the twenty years' dung will be exhausted.

In the same field all the plots which have been manured with rape-cake showed by analyses that the soil contained a considerably larger amount of nitrogen than any of the plots where minerals, or minerals with salts of ammonia or nitrate, had been used. While therefore fertility may be stored up in the soil in the form of such mineral substances as potash or phosphate, it does not appear that the more valuable substance, nitrogen, can be stored up unless as united with carbon. Or in other words, while the soil fixes potash and phosphoric acid independent of vegetation, nitric acid is only fixed by the agency of vegetation.

SUMMARY AND GENERAL CONCLUSIONS.

THE SOIL.

1. A soil which in the ordinary course of agriculture would have received an application of manure before another crop was sown, has produced forty crops of wheat in succession, averaging 14 bushels per acre, solely by means of its existing fertility.

2. At the commencement of the experiment the soil contained a large amount of organic nitrogen, derived from the *débris* of pre-existing vegetation. It also contained a large amount of the mineral food of plants.

3. Every year a certain proportion of the organic nitrogen has been nitrified by organisms existing in the soil.

4. Part of the nitrates formed has been employed in the growth of the wheat crop; part has been washed out of the soil or otherwise lost.

5. The loss of nitric acid is greater in wet seasons, and the amount taken up by the wheat crop is in consequence smaller. Dry seasons should therefore be favourable for the production of large crops of wheat.

6. The stock of soil fertility in the form of organic nitrogen has been considerably reduced during the forty years that the experiments have been carried on; and the amount of such reduc-

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tion has been ascertained by analyses of the soil made at different periods. The stock of both potash and phosphoric acid has also been largely reduced.

7. Although so much soil fertility has been removed, the stock that remains would appear to be sufficient to grow crops of wheat for a very long period; the produce, however, must in process of time necessarily be lower than it has hitherto been.

Manures.

8. Mineral manures alone have added very slightly to the produce grown upon the unmanured land.

9. Manures containing nitric acid alone, or some compound of nitrogen which is easily nitrified, have considerably increased the crop.

10. The soil therefore contained a stock of minerals which the wheat crop was unable to make use of, owing to the insufficient supply of nitrogen in some available form.

11. Manures consisting of potash, phosphoric acid, and ammonia or nitrates, appear competent to grow large crops of wheat continuously.

12. A given weight of nitrogen as nitric acid, has produced more growth in the wheat crop than the same weight of nitrogen in salts of ammonia.

13. The amount of nitrogen supplied in manures is very much in excess of the amount recovered in the increase of the crop.

14. After a certain amount of growth has been reached, each increase of crop requires a proportionately larger application of manure. When the price of grain is high, larger crops can be grown more profitably than when the price is low.

15. When farmyard dung is employed to grow wheat, a considerably larger amount of nitrogen must be applied to produce a given increase in the crop, as much of the nitrogen contained in the dung is not in an active form.

16. A given weight of nitrogen, in the form of nitric acid, will produce more growth in the crop to which it is applied than the same weight of nitrogen in dung; but the influence of the nitrate upon succeeding crops will be very much less.

17. There is no evidence to show whether the whole available effect of the nitrogen in one manure is greater than it is in the other.

Unexhausted Manures.

18. In the absence of vegetation, or when applied to crops in excess of their requirement, both potash and phosphoric acid form insoluble compounds with the soil and become available for future crops.

19. In the absence of vegetation, or when the amount supplied is in excess of the requirements of the crop, nitrates and salts of ammonia do not appear to form permanent compounds with the soil, but, on the contrary, are liable to be washed out by rain, or to be otherwise lost.

20. The application of a larger amount of nitrogen, as nitrates or salts of ammonia, than the crop could utilize owing to a want of minerals, does not appear to prevent the nitrification of the organic nitrogen of the soil.

21. The stock of nitrogen of the soil itself, therefore, may be reduced, although the annual application of nitrogen may be much in excess of the amount of that substance removed in the crop.

22. When large crops of wheat have been grown by the application of nitrates, or salts of ammonia with mineral manures, the soil does not appear to have gained or lost fertility. Nitrification of the organic matter in the soil may have gone on as usual, but the loss has been made good by the amount of nitrogen stored up in the stubble and underground roots of the large crops previously grown.

23. When dung is applied continuously to land, the accumulation of unexhausted fertility becomes very large, and the removal by crops of the substance accumulated would extend over a long series of years.

24. Dung applied to land in the ordinary processes of agriculture will not be entirely exhausted until a considerable number of years have elapsed from the time of its first application.

APPENDIX-TABLES.

I.—XXVII.

To face p 448.

NOTES TO APPENDIX-TABLE I. (p. 1).

(APPENDIX-TABLE I. is intended to be drawn out to the left, free of the book, as it has reference to the succeeding Tables.)

([1]) 1858 *and previously.*—Sulphate of Potash, 600 lbs. per acre per annum on Plot 1, and 300 lbs. on all plots which now receive 200 lbs. per acre. Sulphate of Soda, 400 lbs. on Plot 1, and 200 lbs. on all plots where 100 lbs. is now applied. Plots 12A and 12B, Sulphate of Soda 550 lbs. per acre per annum. Plots 14A and 14B, Sulphate of Magnesia 420 lbs. per acre per annum.

([2]) PLOT 9A.—1852, Nitrate of Soda 475 lbs. per acre; 1853 and 1854, 275 lbs. only. No minerals were applied to this plot in either of these 3 years.

([3]) PLOT 9B.—475 lbs. Nitrate of Soda in 1852.

([4]) PLOTS 15A and 15B.—1873 and since, Superphosphate made with 150 lbs. Sulphuric Acid. For the crop of 1873 and since, Rape-cake has been omitted on 15B; and instead of the 400 lbs. Sulphate of Ammonia on 15A, and 300 lbs. Sulphate of Ammonia on 15B, each plot has received 200 lbs. Sulphate, and 200 lbs. Muriate of Ammonia, in addition to the mineral manures.

([5]) PLOTS 16A and 16B.—Unmanured for the crop of 1865 and since.

([6]) PLOTS 17A and 17B, and 18A and 18B.—On these plots the manures have alternated each year since 1852; that is, Ammonia-salts on Plots 17A and 17B, and the mixed mineral manure on Plots 18A and 18B in one year; mineral manure on Plots 17A and 17B, and Ammonia-salts on Plots 18A and 18B in the next year, and so on.

([7]) PLOT 19.—1879–82 inclusive, Rape-cake alone, 1700 lbs. per acre per annum; 1883, increased to 1889 lbs. (containing Nitrogen = to 400 lbs. Ammonia-salts).

([8]) PLOT 20.—In 1880 this plot was divided, and since one portion (20–1) has been manured with Rape-cake alone, as Plot 19, the other portion (20–2) being left unmanured as before.

Application of Cut Wheat Straw.—For the crops of 1868 to 1879 inclusive, cut straw (that produced on the respective plots in the previous season), was applied on the "A" portions of Plots 5, 6, 7, 8, 11, 12, 13, 14, and 17 (or 18); also for the crop of 1874, and each succeeding crop to 1879 inclusive, the straw of the previous season was cut up and applied to the "A" portion of Plot 15. For the crop of 1880, and since, the return of the straw has been discontinued.

Spring and Autumn Sowing of Manures.—From the commencement of the experiments in 1843–4 up to 1876–7 inclusive, the mineral manures, the ammonia-salts, and rape-cake, &c., were sown in the autumn before the seed; excepting in 1845, when, owing to the wet autumn and winter, all the manures were spring-sown; and for the crops of 1873, '4, '5, '6, and '7, the ammonia-salts applied to Plots 15A and 15B were top-dressed in the spring. Nitrate of Soda has, however, always been sown in the spring. But, in consequence of the ascertained great loss of the nitrogen of the manures by drainage, especially in wet winters, it was decided to apply only the mineral manures (and farmyard-manure) in the autumn, and the ammonia-salts, as well as the nitrate, in the spring; excepting on Plots 15A and 15B, where, for comparison, the ammonia-salts are sown in the autumn. This plan was adopted for the crops of 1878 to 1883 inclusive.

Appendix-Table I.—Manures per Acre, per Annum, for the whole of the 20 Years 1864–38, and also for the 12 Years previously, 1852–63, making altogether 32 Years; with the exceptions explained in the notes on page 2.

Plots.	Manures per Acre, per Annum.										
	Farm-yard-Manure.	Sulphate of Potash ([1]).	Sulphate of Soda. ([1]).	Sulphate of Magnesia. ([1]).	Superphosphate of Lime.			Sulphate of Ammonia.	Muriate of Ammonia.	Nitrate of Soda.	Rape Cake.
					Bone Ash.	Sulphuric Acid. (Sp. gr. 1·7.)	Muriatic Acid.				
	Tons.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0	..	..	..	..	600	450	..	..	..	..	..
1	..	400	200	200	..	..	..	..	..	..	..
2	14	..	..	..	..	..	..	..	..	..	..
3	Unmanured		..	..	..	..	..	..	..	..	..
4	Unmanured		..	..	..	..	..	..	..	..	..
5A	..	200	100	100	200	150	..	..	..	..	..
5B	..	200	100	100	200	150	..	..	..	..	..
6A	..	200	100	100	200	150	..	100	100	..	..
6B	..	200	100	100	200	150	..	100	100	..	..
7A	..	200	100	100	200	150	..	200	200	..	..
7B	..	200	100	100	200	150	..	200	200	..	..
8A	..	200	100	100	200	150	..	300	300	..	..
8B	..	200	100	100	200	150	..	300	300	..	..
([2]) 9A	..	200	100	100	200	150	..	..	..	550	..
([3]) 9B	..	..	..	..	..	..	..	..	..	550	..
10A	..	..	..	..	..	..	..	200	200	..	..
10B	..	..	..	..	..	..	..	200	200	..	..
11A	..	..	..	..	200	150	..	200	200	..	..
11B	..	..	..	..	200	150	..	200	200	..	..
12A	..	..	366½	..	200	150	..	200	200	..	..
12B	..	..	366½	..	200	150	..	200	200	..	..
13A	..	200	..	..	200	150	..	200	200	..	..
13B	..	200	..	..	200	150	..	200	200	..	..
14A	..	..	..	280	200	150	..	200	200	..	..
14B	..	..	..	280	200	150	..	200	200	..	..
([4]) 15A	..	200	100	100	200	..	200	400	..	..	..
([4]) 15B	..	200	100	100	200	..	200	300	..	..	500
([5]) 16A	..	200	100	100	200	150	..	400	400	..	..
([5]) 16B	..	200	100	100	200	150	..	400	400	..	..
([6]) 17A	..	200	100	100	200	150	..	..	..	..	..
([6]) 17B	..	200	100	100	200	150	..	..	..	..	..
([6]) 18A	..	..	..	..	..	..	..	200	200	..	..
([6]) 18B	..	..	..	..	..	..	..	200	200	..	..
([7]) 19	..	..	..	..	200	..	200	300	..	..	500
([8]) 20	Unmanured		..	..	..	..	..	..	..	..	..
21	..	200	100	100	200	150	..	..	100	..	..
22	..	200	100	100	200	150	..	100	..	..	..

APPENDIX-TABLE II.—PRODUCE of the 21st SEASON, 1863–4. SEED (RED ROSTOCK) sown NOVEMBER 16, 1863; CROP cut AUGUST 12–16, and carted AUGUST 19 and 20, 1863.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.) Dressed Grain. Quantity.		Dressed Grain. Weight per Bushel.	Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Increase per Acre by Manure. Grain.	Straw and Chaff.	Total Produce.	Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	19	0	62·0	64	1241	1575	2816	163	225	388	5·4	78·8
1	14	3¾	62·0	37	962	1296	2258	−116	− 54	−170	3·9	74·2
2	40	0	62·5	96	2595	3893	6488	1517	2543	4060	3·8	66·7
3	16	1¾	62·0	56	1078	1350	2428	..	..	..	5·5	79·8
4	17	0¼	61·9	27	1085	1337	2422	7	− 13	− 6	2·6	81·2
5A	16	1	62·1	44	1052	1293	2345	− 26	− 57	− 83	4·4	81·4
5B	17	2	62·0	35	1121	1458	2579	43	108	151	3·2	76·9
6A	31	1½	62·0	70	2016	3630	5646	938	2280	3218	3·6	55·5
6B	30	3¼	62·0	68	1978	3127	5105	900	1777	2677	3·6	63·3
7A	44	1¼	63·0	117	2912	4897	7809	1834	3547	5381	4·2	59·5
7B	47	1	63·1	104	3087	5043	8130	2009	3693	5702	3·5	61·2
8A	49	3	63·5	124	3284	5585	8869	2206	4235	6441	3·9	58·8
8B	50	0	63·5	124	3300	5590	8890	2222	4240	6462	3·9	59·0
9A	51	0¼	62·6	134	3330	5985	9315	2252	4635	6887	4·2	55·7
9B	33	1	61·7	128	2182	3287	5469	1104	1937	3041	6·2	66·4
10A	32	0¼	61·8	112	2093	2832	4925	1015	1482	2497	5·6	73·9
10B	36	0¾	62·1	148	2395	3247	5642	1317	1897	3214	6·6	73·8
11A	34	2	59·7	148	2210	3440	5650	1132	2090	3222	7·2	64·2
11B	38	1½	59·0	128	2394	3878	6272	1316	2528	3844	5·6	61·7
12A	44	1¾	62·6	99	2881	4315	7196	1803	2965	4768	3·6	66·8
12B	44	3	62·4	93	2882	4356	7238	1804	3006	4810	3·3	66·2
13A	42	2¾	63·2	88	2785	4480	7265	1707	3130	4837	3·2	62·2
13B	43	2¾	63·4	111	2882	4620	7502	1804	3270	5074	4·0	62·4
14A	41	0¼	63·1	149	2740	4003	6743	1662	2653	4315	5·8	68·4
14B	41	3¾	62·8	110	2745	4107	6852	1667	2757	4424	4·2	66·8
15A	37	2¼	63·1	90	2459	4003	6462	1381	2653	4034	3·8	61·4
15B	37	1	63·0	74	2421	4010	6431	1343	2660	4003	3·2	60·4
16A	50	3½	63·2	118	3333	6003	9336	2255	4653	6908	3·7	55·5
16B	51	1½	63·2	125	3370	5990	9360	2292	4640	6932	3·8	56·3
17A	36	2¼	62·6	88	2378	3920	6298	1300	2570	3870	3·8	60·7
17B	35	3¼	62·6	74	2316	3667	5983	1238	2317	3555	3·3	63·2
18A	17	0¼	61·3	33	1078	1460	2538	none	110	110	3·2	73·8
18B	18	1¼	61·6	43	1169	1600	2769	91	250	341	3·8	73·0
19	37	0½	62·3	127	2440	3363	5803	1362	2013	3375	5·5	72·6
20	13	2	63·3	73	929	1332	2261	−149	− 18	−167	8·6	69·7
21	24	3¼	62·3	80	1625	2323	3948	547	973	1520	5·2	70·0
22	25	1½	62·0	68	1642	2180	3822	564	830	1394	4·3	75·3

APPENDIX-TABLE III.—PRODUCE of the 22nd SEASON, 1864–5. SEED (RED ROSTOCK) sown NOVEMBER 10, 1864; CROP cut AUGUST 10–12.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	15	2	59·0	78	993	1135	2128	165	102	267	8·5	87·5
1	12	1½	59·0	71	802	1064	1866	− 26	31	5	9·7	75·3
2	37	0½	61·5	100	2384	3100	5484	1556	2067	3623	4·4	76·9
3	13	1¼	60·6	22	828	1033	1861	..	..	..	2·7	80·2
4	14	2¾	60·3	63	950	1162	2112	122	129	251	7·1	81·7
5A	14	0¾	61·0	43	910	1132	2042	82	99	181	5·0	80·4
5B	14	0¾	60·8	59	920	1220	2140	92	187	279	6·9	75·4
6A	24	3¼	61·0	78	1589	1978	3567	761	945	1706	5·1	80·3
6B	25	0	60·9	101	1621	2063	3684	793	1030	1823	6·6	78·6
7A	40	0	61·6	87	2550	3598	6148	1722	2565	4287	3·5	70·9
7B	40	1¾	61·7	115	2609	3740	6349	1781	2707	4488	4·6	69·8
8A	43	3½	61·3	120	2809	4517	7326	1981	3484	5465	4·5	62·2
8B	43	1¼	61·5	190	2857	4682	7539	2029	3649	5678	7·1	61·0
9A	44	0¼	61·1	189	2881	4682	7563	2053	3649	5702	7·0	61·5
9B	29	2¼	59·5	248	2005	3137	5142	1177	2104	3281	14·1	63·9
10A	25	0¾	59·6	145	1649	2385	4034	821	1352	2173	9·7	69·1
10B	30	1¾	59·8	119	1938	2677	4615	1110	1644	2754	6·5	72·4
11A	26	2¼	57·2	178	1696	2397	4093	868	1364	2232	11·7	70·8
11B	28	0¼	57·3	172	1780	2662	4442	952	1629	2581	10·7	66·9
12A	35	0¾	60·0	163	2277	3067	5344	1449	2034	3483	7·7	74·3
12B	33	3¾	60·3	172	2220	3148	5368	1392	2115	3507	8·4	70·5
13A	35	3	61·1	143	2328	3243	5571	1500	2210	3710	6·6	71·8
13B	38	2	61·1	154	2506	3518	6024	1678	2485	4163	6·6	71·2
14A	36	0¼	60·3	170	2345	3127	5472	1517	2094	3611	7·8	75·0
14B	37	0¼	60·4	150	2390	3195	5585	1562	2162	3724	6·7	74·8
15A	35	1¾	60·9	135	2291	3142	5433	1463	2109	3572	6·3	72·9
15B	36	1	61·6	177	2411	3375	5786	1583	2342	3925	7·9	71·4
16A	32	0	61·8	135	2113	2837	4950	1285	1804	3089	6·8	74·5
16B	32	2½	61·7	114	2125	2938	5063	1297	1905	3202	5·7	72·3
17A	16	3½	60·9	68	1097	1488	2585	269	455	724	6·6	73·7
17B	17	0¾	60·6	58	1098	1452	2550	270	419	689	5·5	75·6
18A	30	0½	60·1	105	1916	2785	4701	1088	1752	2840	5·8	68·8
18B	32	3	60·3	91	2065	2877	4942	1237	1844	3081	4·6	71·8
19	32	3½	58·9	147	2083	2987	5070	1255	1954	3209	7·6	69·7
20	13	2¾	60·2	67	889	1307	2196	61	274	335	8·1	68·0
21	18	1¼	58·0	66	1128	1458	2586	300	425	725	6·3	77·4
22	19	0¾	58·3	76	1195	1527	2722	367	494	861	6·8	78·3

APPENDIX-TABLE IV.—PRODUCE of the 23rd SEASON, 1865–6. SEED (RED ROSTOCK) sown NOVEMBER 10, 1865; CROP cut AUGUST 12–15, and carted AUGUST 27th.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	16	3	60·0	27	1033	1729	2762	256	460	716	2·7	59·7
1	11	1¾	59·8	25	709	1301	2010	– 68	32	– 36	3·6	54·5
2	32	2½	61·7	59	2070	4058	6128	1293	2789	4082	2·9	51·0
3	12	0½	61·3	33	777	1269	2046	..	..	..	4·4	61·2
4	13	1½	60·9	38	852	1419	2271	75	150	225	4·7	60·0
5A	13	0½	60·8	38	832	1454	2286	55	185	240	4·5	57·2
5B	13	1½	61·0	35	843	1476	2319	66	207	273	3·5	57·1
6A	19	3½	61·0	43	1255	2207	3462	478	938	1416	3·6	56·9
6B	21	0¼	61·0	47	1333	2289	3622	556	1020	1576	3·7	58·2
7A	30	0¼	61·1	60	1897	3844	5741	1120	2575	3695	3·3	49·4
7B	29	3	60·9	72	1885	3923	5808	1108	2654	3762	4·0	48·1
8A	32	0	60·0	136	2057	5318	7375	1280	4049	5329	7·1	38·7
8B	32	1	60·2	110	2051	5306	7357	1274	4037	5311	5·7	38·7
9A	32	2	60·6	94	2061	5316	7377	1284	4047	5331	4·8	38·8
9B	30	3	59·9	138	1979	4682	6661	1202	3413	4615	7·5	42·3
10A	26	1	61·2	88	1693	2792	4485	916	1523	2439	5·5	60·7
10B	28	2	61·5	94	1848	3047	4895	1071	1778	2849	5·4	60·7
11A	27	3½	60·8	95	1789	3130	4919	1012	1861	2873	5·6	57·2
11B	28	0½	60·5	98	1800	3252	5052	1023	1983	3006	5·7	55·4
12A	28	1½	61·0	72	1804	3473	5277	1027	2204	3231	4·2	51·9
12B	28	0¾	61·3	83	1812	3538	5350	1035	2269	3304	4·8	51·2
13A	24	0¾	62·0	77	1576	3350	4926	799	2081	2880	5·1	47·0
13B	25	1¼	61·5	92	1647	3623	5270	870	2354	3224	5·9	45·5
14A	28	1½	61·1	80	1813	3563	5376	1036	2294	3330	4·6	50·9
14B	27	2¼	61·3	77	1768	3367	5135	991	2098	3089	4·5	52·5
15A	26	0	61·6	54	1655	3053	4708	878	1784	2662	3·4	54·2
15B	26	1½	61·4	70	1690	3297	4987	913	2028	2941	4·3	51·3
16A	17	0½	61·9	51	1111	1955	3066	334	686	1020	4·8	56·8
16B	17	2	61·6	50	1127	1968	3095	350	699	1049	4·7	57·3
17A	27	0¾	61·3	71	1739	3365	5104	962	2096	3058	4·3	51·7
17B	25	2½	61·1	78	1643	3582	5225	866	2313	3179	5·0	45·9
18A	12	0¾	60·6	38	775	1502	2277	– 2	233	231	5·2	51·6
18B	13	0¾	60·8	43	846	1533	2379	69	264	333	5·4	55·2
19	26	2¼	59·7	113	1698	3347	5045	921	2078	2999	7·1	50·7
20	13	2½	59·1	32	837	1627	2464	60	358	418	3·9	51·4
21	17	2	59·9	26	1072	2101	3176	295	835	1130	2·5	51·0
22	18	1¾	59·8	23	1123	2127	3250	346	858	1204	2·1	52·8

APPENDIX-TABLE V.—PRODUCE of the 24th SEASON, 1867–7. SEED (RED ROSTOCK) sown NOVEMBER 8, 1866; CROP cut AUGUST 23 and 24, and carted AUGUST 30.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.) Dressed Grain. Quantity.		Weight per Bushel.	Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Increase per Acre by Manure. Grain.	Straw and Chaff.	Total Produce.	Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	10	2½	58·7	41	664	1320	1984	132	347	479	6·6	50·3
1	7	3¼	57·9	34	487	944	1431	− 45	− 29	− 74	7·5	51·6
2	27	2¼	61·4	61	1755	3136	4891	1223	2163	3386	3·6	56·0
3	8	3½	56·1	33	532	973	1505	..	..	..	6·6	54·7
4	9	1	58·6	41	583	999	1582	51	26	77	7·6	58·4
5A	9	2½	59·7	33	609	1099	1708	77	126	203	5·8	55·4
5B	8	3½	59·0	29	551	966	1517	19	− 7	12	5·5	57·1
6A	15	1¼	60·6	43	972	1684	2656	440	711	1151	4·7	57·7
6B	16	0¾	60·5	55	1033	1762	2795	501	789	1290	5·6	58·7
7A	22	3¾	61·3	62	1469	2796	4265	937	1823	2760	4·4	52·5
7B	21	1½	60·7	67	1365	2727	4092	833	1754	2587	5·2	50·1
8A	29	1½	60·8	108	1896	4103	5999	1364	3130	4494	6·0	46·2
8B	31	1¾	60·5	104	2008	4288	6296	1476	3315	4791	5·5	46·8
9A	29	0½	59·9	112	1855	4918	6773	1323	3945	5268	6·4	37·7
9B	22	0½	57·4	124	1392	3246	4638	860	2273	3133	9·8	42·9
10A	18	0½	57·9	77	1123	2023	3146	591	1050	1641	7·3	55·5
10B	19	1½	59·3	88	1237	2138	3375	705	1165	1870	7·7	57·9
11A	21	3¾	59·1	64	1360	2218	3578	828	1245	2073	4·9	61·3
11B	22	1	59·8	84	1416	2402	3818	884	1429	2313	6·3	59·0
12A	25	0½	60·2	65	1577	2628	4205	1045	1655	2700	4·3	60·0
12B	23	3¾	60·6	59	1511	2685	4196	979	1712	2691	4·1	56·3
13A	23	1½	60·8	51	1471	2662	4133	939	1689	2628	3·6	55·3
13B	24	1	60·7	58	1529	2822	4351	997	1849	2846	4·0	54·2
14A	23	0¾	59·8	61	1450	2598	4048	918	1625	2543	4·4	55·8
14B	22	1¼	59·6	70	1398	2537	3935	866	1564	2430	5·2	55·1
15A	22	3½	60·2	51	1427	2670	4097	895	1697	2592	3·7	53·5
15B	23	0½	59·5	56	1435	2730	4165	903	1757	2660	4·1	52·6
16A	14	1½	59·4	35	890	1583	2473	358	610	968	4·1	56·2
16B	14	3¼	59·1	33	907	1643	2550	375	670	1045	3·8	55·2
17A	10	3½	59·2	34	678	1193	1871	146	220	366	5·3	56·8
17B	10	2¾	57·6	42	658	1257	1915	126	284	410	6·8	52·3
18A	22	3	59·1	38	1384	2558	3942	852	1585	2437	2·8	54·1
18B	24	1¾	57·5	45	1448	2675	4123	916	1702	2618	3·2	54·1
19	23	3¾	56·7	63	1421	2620	4041	889	1647	2536	4·7	54·2
20	7	0¾	56·4	28	433	948	1381	− 99	− 25	−124	7·0	45·6
21	12	2¼	59·3	40	787	1388	2175	255	415	670	5·4	56·7
22	12	2¾	59·3	41	791	1377	2168	259	404	663	5·4	57·4

Appendix-Table VI.—Produce of the 25th Season, 1867–8. Seed (Red Rostock) sown November 2, 1867; Crop cut July 22–28, and carted July 25–29.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	22	1¼	61·4	33	1404	1855	3259	350	882	1232	2·4	75·7
1	20	2¼	60·0	27	1259	1594	2853	205	621	826	2·2	79·0
2	41	3	61·6	33	2604	4190	6794	1550	3217	4767	1·3	62·1
3	16	2½	61·0	41	1054	973	2027	..	..	..	4·0	108·4
4	17	2	61·6	27	1103	1345	2448	49	372	421	2·5	82·0
5A	16	1¼	62·2	28	1044	1250	2294	− 10	277	267	2·8	83·5
5B	18	3½	63·5	28	1226	1442	2668	172	469	641	2·4	85·0
6A	27	3	62·4	51	1782	2437	4219	728	1464	2192	3·0	73·1
6B	28	3¾	63·2	57	1887	2700	4587	833	1727	2560	3·1	69·9
7A	40	2	61·5	36	2528	4017	6545	1474	3044	4518	1·5	62·9
7B	39	0¾	60·6	33	2408	3680	6088	1354	2707	4061	1·4	65·4
8A	44	0½	62·1	51	2794	4683	7477	1740	3710	5450	1·9	59·7
8B	48	3½	61·9	40	3069	4933	8002	2015	3960	5975	1·3	62·2
9A	47	3¼	61·1	46	2970	5180	8150	1916	4207	6123	1·6	57·3
9B	27	1	62·0	111	1799	2742	4541	745	1769	2514	6·6	65·6
10A	24	3	61·9	93	1627	2163	3790	573	1190	1763	6·1	75·2
10B	27	2¾	62·4	118	1846	2364	4210	792	1391	2183	6·9	78·1
11A	33	1¾	62·4	124	2211	2790	5001	1157	1817	2974	5·9	79·2
11B	33	2½	62·2	118	2207	2850	5057	1153	1877	3030	5·6	77·4
12A	39	2	63·6	101	2611	3421	6032	1557	2448	4005	4·0	76·4
12B	40	1	63·3	74	2620	3653	6273	1566	2680	4246	2·9	71·7
13A	37	3¼	63·0	34	2417	4010	6427	1363	3037	4400	1·4	60·3
13B	40	2½	63·2	45	2614	4040	6654	1560	3067	4627	1·7	64·7
14A	41	3¾	63·9	37	2716	3685	6401	1662	2712	4374	1·4	73·7
14B	41	1¾	64·1	98	2754	3668	6422	1700	2695	4395	3·7	75·1
15A	44	0½	63·8	43	2856	4656	7512	1802	3683	5485	1·5	61·3
15B	41	2¼	63·3	63	2692	4223	6915	1638	3250	4888	2·4	63·7
16A	23	0	62·9	34	1481	2125	3606	427	1152	1579	2·3	69·7
16B	22	2¼	62·7	25	1438	1962	3400	384	989	1373	1·8	73·3
17A	38	0¼	63·4	53	2466	3767	6233	1412	2794	4206	2·2	65·5
17B	36	3	64·2	55	2413	3527	5940	1359	2554	3913	2·4	68·4
18A	18	0¾	62·7	28	1168	1537	2705	114	564	678	2·5	76·0
18B	19	0¾	62·9	31	1239	1672	2911	185	699	884	2·6	74·1
19	36	3¾	62·9	98	2422	3161	5583	1368	2188	3556	4·2	76·6
20(¹)	..		..	..	..	..	..	..	..	..	..	..
21	26	1	62·6	44	1687	2267	3954	633	1294	1927	2·7	74·4
22	24	3¾	62·8	48	1615	2300	3915	561	1327	1888	3·1	70·2

(¹) Produce unknown, owing to a mistake at Harvest.

APPENDIX-TABLE VII.—PRODUCE of the 26th SEASON, 1868–9. SEED (RED ROSTOCK) sown NOVEMBER 3, 1868; CROP cut AUGUST 16–18, and carted AUGUST 21 and 24.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw.)	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	15	1¼	58·1	66	955	1493	2448	107	143	250	7·5	64·0
1	12	0¾	58·2	36	744	1180	1924	−104	−170	−274	5·1	63·1
2	38	1	56·9	80	2256	3937	6193	1408	2587	3995	3·7	57·3
3	14	1	56·1	48	848	1350	2198	..	..	..	5·9	62·8
4	14	3¼	57·1	50	896	1405	2301	48	55	103	5·9	63·7
5A	15	2¼	56·8	45	928	1514	2442	80	164	244	5·1	61·3
5B	15	3½	57·0	53	956	1687	2643	108	337	445	5·9	56·7
6A	21	0½	57·0	69	1273	2250	3523	425	900	1325	5·7	56·6
6B	22	0¼	57·3	80	1345	2280	3625	497	930	1427	6·4	59·0
7A	28	2¼	57·7	101	1748	3114	4862	900	1764	2664	6·1	56·1
7B	28	1	57·2	156	1771	3309	5080	923	1959	2882	9·7	53·5
8A	35	0¼	57·0	107	2105	3898	6003	1257	2548	3805	5·4	54·0
8B	34	1¾	57·5	108	2086	3937	6023	1238	2587	3825	5·4	53·0
9A	39	0	57·1	140	2368	4930	7298	1520	3580	5100	6·3	48·0
9B	24	0½	54·6	136	1452	3475	4927	604	2125	2729	10·3	41·8
10A	20	1	54·9	99	1210	2265	3475	362	915	1277	8·9	53·4
10B	19	0½	55·6	125	1188	2186	3374	340	836	1176	11·8	54·3
11A	24	0¼	56·2	91	1443	2568	4011	595	1218	1813	6·8	56·2
11B	20	1½	55·1	128	1251	2345	3596	403	995	1398	11·4	53·4
12A	26	1¾	58·1	102	1638	2637	4275	790	1287	2077	6·6	62·1
12B	28	0¼	57·9	100	1726	3008	4734	878	1658	2536	6·1	57·4
13A	25	2¾	59·3	110	1631	2826	4457	783	1476	2259	7·3	57·7
13B	28	3½	59·0	125	1827	3267	5094	979	1917	2896	7·3	55·9
14A	28	1	58·5	128	1778	3076	4854	930	1726	2656	7·8	57·8
14B	27	0½	58·1	126	1701	2999	4700	853	1649	2502	8·0	56·7
15A	26	2¼	58·1	93	1635	2954	4589	787	1604	2391	6·0	55·4
15B	27	0½	59·3	88	1694	3008	4702	846	1658	2504	5·5	56·3
16A	16	1¾	58·6	54	1019	1678	2697	171	328	499	5·6	60·8
16B	15	3¼	58·1	64	982	1614	2596	134	264	398	7·0	60·9
17A	15	1	58·1	64	952	1570	2522	104	220	324	7·2	60·7
17B	17	0	57·3	86	1059	1829	2888	211	479	690	8·9	57·9
18A	23	0¼	58·7	78	1431	2433	3864	583	1083	1666	5·7	58·8
18B	22	3¼	58·0	94	1418	2460	3878	570	1110	1680	7·1	57·6
19	23	0¾	56·7	133	1447	2566	4013	599	1216	1815	10·1	56·4
20	13	0¾	56·9	77	826	1253	2079	− 22	− 97	−119	10·2	65·9
21	20	2½	58·1	63	1260	2115	3375	412	765	1177	5·3	59·6
22	15	0¾	58·1	60	942	1483	2425	94	133	227	6·8	63·5

APPENDIX-TABLE VIII.—PRODUCE of the 27th SEASON, 1869–70. SEED (RED ROSTOCK) sown NOVEMBER 3, 1869; CROP cut AUGUST 5–12, and carted AUGUST 11–15.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)						Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.		Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.	Weight per Bushel.									
	bush. pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	21 2¾	62·1	69	1415	1239	2654	459	193	652	5·1	114·3
1	16 0¾	62·5	45	1056	1087	2143	100	41	141	4·5	97·1
2	36 2	63·4	44	2359	2733	5092	1403	1687	3090	1·9	86·3
3	14 3¾	61·8	31	956	1046	2002	..	..	..	3·3	91·3
4	15 2¾	62·6	39	1023	1107	2130	67	61	128	4·0	92·4
5A	18 0¾	62·6	40	1178	1302	2480	222	256	478	3·6	90·5
5B	19 0¾	62·6	28	1228	1419	2647	272	373	645	2·3	86·6
6A	29 3	63·0	63	1936	2269	4205	980	1223	2203	3·4	85·3
6B	31 0½	63·1	58	2023	2438	4461	1067	1392	2459	3·0	83·0
7A	39 2¾	63·3	59	2568	3148	5716	1612	2102	3714	2·4	81·6
7B	41 1½	63·2	56	2672	3284	5956	1716	2238	3954	2·1	81·4
8A	45 3¾	63·7	66	2992	3635	6627	2036	2589	4625	2·3	82·3
8B	44 2	63·8	100	2939	3699	6638	1983	2653	4636	3·6	79·5
9B	45 2	62·7	89	2940	3911	6851	1984	2865	4849	3·1	75·2
9B	26 1¾	61·3	115	1735	2080	3815	779	1034	1813	7·1	83·4
10A	21 2¾	60·8	100	1420	1627	3047	464	581	1045	7·6	87·3
10B	23 0¾	60·8	88	1496	1748	3244	540	702	1242	6·2	85·6
11A	25 0½	60·8	128	1653	1917	3570	697	871	1568	8·4	86·2
11B	25 1¾	60·7	139	1682	1895	3577	726	849	1575	9·0	88·8
12A	36 2	62·4	72	2347	2577	4924	1391	1531	2922	3·2	91·1
12B	34 0	62·5	93	2218	2503	4721	1262	1457	2719	4·4	88·6
13A	35 2¼	63·7	64	2328	2815	5143	1372	1769	3141	2·8	82·7
13B	38 1½	63·9	82	2535	2993	5528	1579	1947	3526	3·4	84·7
14A	35 0½	63·2	117	2336	2584	4920	1380	1538	2918	5·4	90·4
14B	36 1	62·7	125	2398	2588	4986	1442	1542	2984	5·5	92·6
15A	38 0¾	63·8	68	2502	3072	5574	1546	2026	3572	2·8	81·5
15B	38 2½	63·9	80	2550	3119	5669	1594	2073	3667	3·3	81·8
16A	18 1¼	63·2	48	1207	1365	2572	251	319	570	4·2	88·4
16B	18 0¾	63·3	56	1208	1333	2541	252	287	539	4·9	90·7
17A	33 1½	63·6	63	2187	2628	4815	1231	1582	2813	3·0	83·2
17B	35 1	63·7	70	2315	2715	5030	1359	1669	3028	3·1	85·3
18A	17 3	63·1	56	1175	1259	2434	219	213	432	5·0	93·3
18B	20 1	63·3	53	1335	1488	2823	379	442	821	4·1	89·7
19	32 1	62·3	128	2137	2242	4379	1181	1196	2377	6·4	95·4
20	14 2¾	62·5	23	943	1175	2118	− 13	129	116	2·5	80·3
21	25 3	63·1	39	1666	1949	3615	710	903	1613	2·5	85·4
22	26 2¼	63·0	49	1723	1996	3719	767	950	1717	2·9	86·3

Appendix-Table IX.—Produce of the 28th Season, 1870–1. Seed (Red Rostock) sown November 1 and 2, 1870; Crop cut August 21–23, and carted August 28–31.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	13	3¾	56·5	102	889	1566	2455	274	466	740	13·0	56·7
1	10	1¼	57·0	97	685	1451	2136	70	351	421	16·5	47·2
2	38	3¾	60·0	161	2498	4506	7004	1883	3406	5289	6·9	55·5
3	9	1¼	54·8	106	615	1100	1715	..	..	..	20·9	55·9
4	10	1¼	57·0	118	708	1277	1985	93	177	270	20·1	55·4
5A	11	0	56·4	97	718	1340	2058	103	240	343	15·6	53·6
5B	12	3	56·7	103	827	1529	2356	212	429	641	14·3	54·1
6A	16	3¾	56·8	138	1099	2290	3389	484	1190	1674	14·3	48·0
6B	17	0	56·3	123	1078	2304	3382	463	1204	1667	12·8	46·8
7A	22	0¾	56·0	263	1503	3093	4596	888	1993	2881	21·2	48·6
7B	22	1¼	57·3	245	1520	3076	4596	905	1976	2881	19·2	49·4
8A	26	1	57·1	247	1745	3716	5461	1130	2616	3746	16·5	47·0
8B	29	0½	58·3	240	1940	4150	6090	1325	3050	4375	14·2	46·7
9A	34	1¾	58·6	210	2228	4909	7137	1613	3809	5422	10·5	45·4
9B	17	2½	52·4	171	1093	2425	3518	478	1325	1803	18·6	45·1
10A	10	0½	53·8	130	675	1252	1927	60	152	212	24·0	53·9
10B	10	0	53·8	125	663	1339	2002	48	239	287	23·2	49·5
11A	12	0¼	54·3	139	795	1448	2243	180	348	528	21·2	54·9
11B	9	3½	53·8	137	668	1279	1947	53	179	232	25·8	52·2
12A	22	2¾	56·5	177	1458	2700	4158	843	1600	2443	13·8	54·0
12B	19	1¾	55·6	178	1259	2440	3699	644	1340	1984	16·4	51·6
13A	28	1	57·6	184	1812	3433	5245	1197	2333	3530	11·3	52·8
13B	32	0¼	58·2	185	2050	4125	6175	1435	3025	4460	9·9	49·7
14A	26	2¼	57·0	213	1728	3063	4791	1113	1963	3076	14·1	56·4
14B	21	3¾	56·7	246	1490	2937	4427	875	1837	2712	19·8	50·8
15A	29	1¼	59·0	177	1905	3597	5502	1290	2497	3787	10·2	53·0
15B	32	0¼	58·7	209	2093	3808	5901	1478	2708	4186	11·1	55·0
16A	13	1	57·2	78	836	1510	2346	221	410	631	10·2	55·4
16B	13	3	56·5	64	841	1573	2414	226	473	699	8·2	53·5
17A	13	1½	56·0	74	824	1608	2432	209	508	717	9·8	51·3
17B	18	2	56·8	78	1129	2032	3161	514	932	1446	7·4	55·6
18A	28	0¼	58·6	118	1763	3254	5017	1148	2154	3302	7·2	54·2
18B	28	3	58·0	124	1792	3428	5220	1177	2328	3505	7·4	52·3
19	22	1¼	56·0	165	1413	2688	4101	798	1588	2386	13·2	52·6
20	10	1¾	55·8	83	665	1350	2015	50	250	300	14·3	49·3
21	15	0¾	56·8	115	979	1873	2852	364	773	1137	13·4	52·3
22	16	3	56·9	113	1067	1871	2938	452	771	1223	11·8	57·0

APPENDIX-TABLE X.—PRODUCE of the 29th SEASON, 1871–2. SEED (RED ROSTOCK) sown OCTOBER 28, 1871; CROP cut AUGUST 16 and 17, and carted AUGUST 20 and 21.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	17	1	58·7	46	1060	1873	2933	355	721	1076	4·6	56·6
1	10	3½	57·9	72	701	1270	1971	– 4	118	114	11·5	55·2
2	32	1½	60·7	80	2046	3761	5807	1341	2609	3950	4·1	54·4
3	10	2¾	59·0	76	705	1152	1857	..	..	..	12·1	61·2
4	11	1¼	57·6	65	717	1216	1933	12	64	76	10·0	59·0
5A	12	3¾	60·2	58	836	1301	2137	131	149	280	7·4	64·3
5B	12	2½	59·8	77	833	1361	2194	128	209	337	10·1	61·2
6A	20	3¼	60·1	58	1308	2770	4078	603	1618	2221	4·6	47·2
6B	20	0¾	60·3	82	1299	2363	3662	594	1211	1805	6·7	55·0
7A	30	1¼	60·4	103	1936	3611	5547	1231	2459	3690	5·6	53·6
7B	29	0¼	60·0	191	1937	4043	5980	1232	2891	4123	10·9	47·9
8A	37	0¼	60·5	164	2404	5430	7834	1699	4278	5977	7·3	44·3
8B	34	0¼	60·4	188	2244	4712	6956	1539	3560	5099	9·1	47·6
9A	40	2¾	60·0	124	2565	6527	9092	1860	5375	7235	5·1	39·3
9B	23	1½	55·5	138	1434	3210	4644	729	2058	2787	10·6	44·7
10A	18	0	56·8	157	1178	2442	3620	473	1290	1763	15·4	48·2
10B	18	2¾	55·9	122	1166	2440	3606	461	1288	1749	11·6	47·8
11A	27	0	59·5	160	1766	3387	5153	1061	2235	3296	10·0	52·2
11B	27	1¾	58·6	152	1758	3450	5208	1053	2298	3351	9·4	51·0
12A	30	0	60·1	126	1928	3933	5861	1223	2781	4004	7·0	49·0
12B	28	2	59·4	130	1824	3388	5212	1119	2236	3355	7·7	53·9
13A	30	1¼	60·3	117	1946	3988	5934	1241	2836	4077	6·4	48·8
13B	29	2	60·8	130	1923	3808	5731	1218	2656	3874	7·3	50·5
14A	31	0¾	59·8	129	1995	3850	5845	1290	2698	3988	6·9	51·8
14B	29	1¾	59·5	144	1897	3725	5622	1192	2573	3765	8·2	50·9
15A	30	0¼	60·5	146	1961	4011	5972	1256	2859	4115	8·1	48·9
15B	32	1¼	60·7	133	2095	4134	6229	1390	2982	4372	6·8	50·7
16A	13	3¼	59·5	54	874	1642	2516	169	490	659	6·6	53·3
16B	12	1¾	59·3	55	791	1466	2257	86	314	400	7·5	54·0
17A	25	3	60·8	119	1685	3249	4934	980	2097	3077	7·6	51·9
17B	26	0¼	60·5	95	1673	3358	5031	968	2206	3174	6·0	49·8
18A	12	1¾	59·3	83	818	1579	2397	113	427	540	11·2	51·8
18B	13	1¾	59·5	61	862	1761	2623	157	609	766	7·7	49·0
19	27	2¾	59·6	145	1794	3303	5097	1089	2151	3240	8·8	54·3
20	11	1½	57·1	48	696	1247	1943	– 9	95	86	7·3	55·8
21	20	3¼	59·6	71	1312	2216	3528	607	1064	1671	5·7	59·2
22	20	0¼	59·8	58	1257	2030	3287	552	878	1430	4·8	61·9

APPENDIX-TABLE XI.—PRODUCE of the 30th SEASON, 1872–3. SEED (RED ROSTOCK) sown NOVEMBER 8, 1872; CROP cut AUGUST 15–19, and carted SEPTEMBER 2.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	15	2¼	57·6	51	950	1183	2133	249	281	530	5·7	80·4
1	10	2	56·6	42	636	966	1602	– 65	64	– 1	7·0	65·8
2	26	3	58·1	67	1622	2463	4085	921	1561	2482	4·3	65·9
3	11	2¾	57·0	35	701	902	1603	..	..	..	5·3	77·7
4	12	0½	57·2	56	749	998	1747	48	96	144	8·1	75·0
5A	12	3½	56·8	40	771	1054	1825	70	152	222	5·5	73·1
5B	12	2	57·0	42	754	1032	1786	53	130	183	5·8	73·0
6A	14	3¼	57·5	52	905	1513	2418	204	611	815	6·1	59·8
6B	16	3¾	56·6	58	1015	1527	2542	314	625	939	6·1	66·4
7A	21	0½	57·0	59	1264	1852	3116	563	950	1513	4·9	68·2
7B	22	3	57·3	77	1381	2190	3571	680	1288	1968	5·9	63·0
8A	25	3¾	57·5	77	1566	2477	4043	865	1575	2440	5·1	63·2
8B	29	0¼	56·3	83	1720	2850	4570	1019	1948	2967	5·4	60·3
9A	35	3¼	57·1	119	2160	3932	6092	1459	3030	4489	5·8	54·9
9B	21	3¼	54·9	104	1303	2358	3661	602	1456	2058	8·7	55·2
10A	19	2½	56·1	74	1173	1635	2808	472	733	1205	6·8	71·7
10B	20	2½	56·5	80	1247	1642	2889	546	740	1286	6·8	75·9
11A	19	0½	56·0	83	1153	1583	2736	452	681	1133	7·8	72·8
11B	19	1¾	55·1	81	1152	1578	2730	451	676	1127	7·5	73·0
12A	22	1¾	56·9	82	1360	1943	3303	659	1041	1700	6·4	70·0
12B	23	1½	56·5	80	1401	2037	3438	700	1135	1835	6·1	68·8
13A	22	3½	57·4	81	1395	2036	3431	694	1134	1828	6·1	68·5
13B	24	0	57·3	64	1440	2107	3547	739	1205	1944	4·6	68·3
14A	23	3¾	57·0	61	1426	2120	3546	725	1218	1943	4·5	67·3
14B	24	1	56·6	78	1452	2172	3624	751	1270	2021	5·7	66·9
15A	32	3¼	57·7	71	1963	2992	4955	1262	2090	3352	3·7	65·6
15B	32	1¼	57·9	73	1941	3165	5106	1240	2263	3503	3·9	61·3
16A	12	2¼	57·4	40	759	1130	1889	58	228	286	5·5	67·2
16B	13	0	57·0	36	778	1174	1952	77	272	349	4·9	66·3
17A	10	2½	56·6	38	639	1092	1731	– 62	190	128	6·3	58·6
17B	12	3¼	57·6	51	789	1108	1897	88	206	294	7·0	71·2
18A	19	2	57·3	61	1177	1805	2982	476	903	1379	5·5	65·2
18B	21	0½	57·6	58	1274	2007	3281	573	1105	1678	4·7	63·5
19	20	0	56·7	80	1212	1858	3070	511	956	1467	7·7	65·3
20	12	2	56·9	47	758	1098	1856	57	196	253	6·6	69·0
21	14	0¼	56·9	52	853	1258	2111	152	356	508	6·4	67·8
22	18	0¼	56·9	54	1084	1663	2747	383	761	1144	5·3	65·2

APPENDIX-TABLE XII.—PRODUCE of the 31st SEASON, 1873–4. SEED (RED ROSTOCK) sown OCTOBER 29 and 30, 1873; CROP cut AUGUST 3–11, and carted AUGUST 15 and 17.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	16	3½	59·1	18	1014	1328	2342	320	338	658	1·8	76·4
1	11	1½	59·6	14	690	972	1662	– 4	– 18	– 22	2·0	71·0
2	39	1	60·2	70	2431	4439	6870	1737	3449	5186	3·0	54·8
3	11	1¾	58·3	27	694	990	1684	..	..	..	4·0	70·1
4	12	1	58·8	13	734	999	1733	40	9	49	1·8	73·5
5A	12	2¼	59·1	23	768	845	1613	74	–145	– 71	3·1	90·8
5B	13	1¾	59·1	24	820	914	1734	126	– 76	50	3·0	89·7
6A	25	2¾	59·7	17	1550	2212	3762	856	1222	2078	1·1	70·1
6B	25	3½	59·5	21	1562	2230	3792	868	1240	2108	1·4	70·0
7A	39	1¼	59·9	78	2436	4508	6944	1742	3518	5260	3·3	54·0
7B	39	2¼	59·7	96	2461	4782	7243	1767	3792	5559	4·1	51·5
8A	41	3½	60·1	121	2637	6182	8819	1943	5192	7135	4·8	42·7
8B	39	0½	59·6	138	2471	5944	8415	1777	4954	6731	5·9	41·6
9A	38	0¾	60·4	105	2409	5012	7421	1715	4022	5737	4·6	48·1
9B	21	2	57·5	31	1269	2166	3435	575	1176	1751	2·5	58·6
10A	25	1	56·5	48	1476	1977	3453	782	987	1769	3·4	74·7
10B	27	0¾	56·9	136	1686	2387	4073	992	1397	2389	8·8	70·6
11A	36	2	57·9	95	2208	3166	5374	1514	2176	3690	4·5	69·7
11B	29	1	58·3	156	1859	3077	4936	1165	2087	3252	9·2	60·4
12A	40	3¾	59·4	65	2497	4011	6508	1803	3021	4824	2·7	62·3
12B	38	0	59·7	88	2359	3774	6133	1665	2784	4449	3·9	62·5
13A	36	3	60·6	75	2303	3952	6255	1609	2962	4571	3·4	58·3
13B	37	1¾	60·4	42	2301	4002	6303	1607	3012	4619	1·9	57·5
14A	37	3¼	59·9	32	2294	3570	5864	1600	2580	4180	1·4	64·2
14B	35	1½	59·2	93	2187	3618	5805	1493	2628	4121	4·4	60·4
15A	27	3	61·3	22	1724	2609	4333	1030	1619	2649	1·3	66·1
15B	30	2½	60·9	36	1901	2943	4844	1207	1953	3160	1·9	64·6
16A	9	0¼	60·2	20	564	913	1477	–130	– 77	–207	3·7	61·8
16B	14	2½	60·0	39	915	1392	2307	221	402	623	4·4	65·7
17A	32	3¼	60·6	40	2027	3501	5528	1333	2511	3844	2·0	57·9
17B	33	2½	60·9	46	2094	3473	5567	1400	2483	3883	2·2	60·3
18A	13	3	58·8	24	832	1047	1879	138	57	195	3·0	79·5
18B	14	0½	58·8	39	871	1012	1883	177	22	199	4·7	86·1
19	37	3¼	58·9	68	2293	3136	5429	1599	2146	3745	3·1	73·1
20	13	3	59·2	32	845	1312	2157	151	322	473	3·9	64·4
21	22	3½	59·5	30	1391	1666	3057	697	676	1373	2·2	83·5
22	21	1½	59·3	21	1289	1547	2836	595	557	1152	1·6	83·3

Appendix-Table XIII.—Produce of the 32nd Season, 1874–5. Seed (Red Rostock) sown October 26 and 27, 1874; Crop cut August 16–21, and carted August 24 and 25.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	10	1¼	59·4	51	663	1150	1813	96	142	238	8·3	57·6
1	8	0¼	58·5	41	511	868	1379	– 56	–140	–196	8·7	58·9
2	28	3¼	60·6	147	1890	3719	5609	1323	2711	4034	8·4	50·8
3	8	2½	60·0	50	567	1008	1575	..	..	..	9·7	56·2
4	7	2½	59·7	51	508	910	1418	– 59	– 98	–157	11·3	55·8
5A	8	1	59·2	37	526	1051	1577	– 41	43	2	7·6	50·1
5B	10	0¾	59·5	46	653	1198	1851	86	190	276	7·6	54·5
6A	15	3¼	60·7	86	1046	1899	2945	479	891	1370	8·9	55·1
6B	16	3¼	59·8	80	1084	2117	3201	517	1109	1626	8·0	51·2
7A	25	0½	59·9	147	1652	3334	4986	1085	2326	3411	9·7	49·6
7B	26	2½	59·0	154	1723	3509	5232	1156	2501	3657	9·8	49·1
8A	31	0½	58·2	194	2006	4400	6406	1439	3392	4831	10·7	45·6
8B	28	2¾	58·1	202	1867	4245	6112	1300	3237	4537	12·1	44·0
9A	30	2	57·9	198	1965	4747	6712	1398	3739	5137	11·2	41·4
9B	16	2	55·7	130	1050	2363	3413	483	1355	1838	14·1	44·4
10A	12	3	54·5	91	786	1574	2360	219	566	785	13·2	50·0
10B	14	2¼	55·6	126	934	1782	2716	367	774	1141	15·5	52·4
11A	19	3¾	55·5	111	1217	2392	3609	650	1384	2034	10·1	50·9
11B	15	3¾	54·6	157	1026	2217	3243	459	1209	1668	18·0	46·3
12A	24	3¾	58·1	135	1585	2972	4557	1018	1964	2982	9·3	53·3
12B	25	2¼	57·2	112	1574	3104	4678	1007	2096	3103	7·7	50·7
13A	26	0¾	60·4	92	1673	3299	4972	1106	2291	3397	5·8	50·7
13B	27	3¾	60·0	93	1766	3231	4997	1199	2223	3422	5·6	54·7
14A	27	2¼	59·0	120	1747	3060	4807	1180	2052	3232	7·4	57·1
14B	25	0	58·0	127	1576	3183	4759	1009	2175	3184	8·8	49·5
15A	23	2¼	59·9	181	1594	2916	4510	1027	1908	2935	12·8	54·7
15B	27	2	60·6	163	1829	3491	5320	1262	2483	3745	9·8	52·4
16A	10	2	59·8	49	676	1222	1898	109	214	323	7·9	55·3
16B	9	3	59·5	35	613	1147	1760	46	139	185	6·0	53·4
17A	11	0¼	58·9	41	691	1247	1938	124	239	363	6·3	55·4
17B	12	1	59·6	48	777	1450	2227	210	442	652	6·6	53·6
18A	25	1	59·2	74	1569	2916	4485	1002	1908	2910	4·9	53·8
18B	25	3½	58·9	76	1598	3096	4694	1031	2088	3119	5·0	51·6
19	22	3½	56·5	98	1392	2494	3886	825	1486	2311	7·6	55·8
20	8	0½	57·0	38	501	1028	1529	– 66	20	– 46	8·2	48·7
21	12	3¾	59·9	66	842	1376	2218	275	368	643	8·5	61·2
22	13	3	60·2	67	893	1491	2384	326	483	809	8·1	59·9

APPENDIX-TABLE XIV.—PRODUCE of the 33rd SEASON, 1875–6. SEED (RED ROSTOCK) sown NOVEMBER 1 and 2, 1875; CROP cut AUGUST 8–19, and carted AUGUST 14–23.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	11	3½	57·3	53	733	830	1563	233	188	421	7·8	88·3
1	7	2	56·8	13	440	571	1011	– 60	– 71	–131	3·1	77·0
2	23	3¼	62·4	58	1545	2140	3685	1045	1498	2543	3·9	72·2
3	8	0½	59·0	21	500	642	1142	..	..	..	4·6	77·9
4	9	0	58·5	18	546	706	1252	46	64	110	3·6	77·4
5A	9	3¾	59·2	20	610	792	1402	110	150	260	3·4	77·0
5B	11	0¼	59·1	25	679	777	1456	179	135	314	3·9	87·4
6A	14	3½	61·9	41	962	1201	2163	462	559	1021	4·4	80·1
6B	16	2	62·2	56	1081	1393	2474	581	751	1332	5·4	77·6
7A	21	1¾	63·2	90	1444	2015	3459	944	1373	2317	6·6	71·6
7B	25	2	62·7	118	1719	2408	4127	1219	1766	2985	7·4	71·4
8A	30	2¾	63·1	121	2054	3083	5137	1554	2441	3995	6·2	66·6
8B	28	2	62·7	111	1895	2788	4683	1395	2146	3541	6·2	68·0
9A	33	1¼	62·7	168	2255	3584	5839	1755	2942	4697	8·0	62·9
9B	13	0	56·3	32	766	1217	1983	266	575	841	4·3	62·9
10A	12	0½	57·2	25	719	922	1641	219	280	499	3·6	78·0
10B	14	1¾	56·4	32	848	1270	2118	348	628	976	3·8	66·7
11A	15	1	59·6	54	963	1313	2276	463	671	1134	6·0	73·4
11B	13	1¾	58·4	49	832	1228	2060	332	586	918	6·3	67·8
12A	19	2¼	61·0	64	1260	1711	2971	760	1069	1829	5·4	73·7
12B	18	3	60·4	74	1206	1661	2867	706	1019	1725	6·5	72·6
13A	24	2	62·1	54	1575	2431	4006	1075	1789	2864	3·6	64·8
13B	25	3¼	62·4	58	1669	2435	4104	1169	1793	2962	3·6	68·6
14A	22	3½	61·4	49	1454	2027	3481	954	1385	2339	3·5	71·7
14B	21	1	60·7	48	1338	1863	3201	838	1221	2059	3·7	71·8
15A	24	3	62·3	63	1602	2320	3922	1102	1678	2780	4·1	69·0
15B	26	0½	61·7	97	1709	2535	4244	1209	1893	3102	6·0	67·4
16A	10	3¾	58·5	18	658	841	1499	158	199	357	2·9	78·2
16B	11	0¼	58·4	25	669	908	1577	169	266	435	3·9	73·7
17A	27	0	61·1	59	1709	2605	4314	1209	1963	3172	3·5	65·6
17B	25	3½	60·6	43	1611	2474	4085	1111	1832	2943	2·7	65·1
18A	10	0½	58·3	19	609	898	1507	109	256	365	3·3	67·8
18B	10	2½	58·5	18	639	893	1532	139	251	390	2·9	71·6
19	19	1	57·6	37	1147	1566	2713	647	924	1571	3·3	73·3
20	7	1½	57·3	19	442	665	1107	– 58	23	– 35	4·5	66·4
21	10	3	57·4	64	681	935	1616	181	293	474	10·3	73·1
22	13	0¾	57·0	67	817	1214	2031	317	572	889	8·9	67·3

APPENDIX-TABLE XV.—PRODUCE of the 34th SEASON, 1876–7. SEED (RED ROSTOCK) sown OCTOBER 23, 1876; CROP cut AUGUST 18–24, and carted AUGUST 30.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)								Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).		Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.										
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.		lbs.	lbs.	lbs.		
0	11	3¾	59·0	23	728	908	1636		185	160	345	3·2	80·2
1	7	0¼	59·3	16	434	521	955		−109	−227	−336	3·8	83·3
2	24	0½	59·1	54	1481	2266	3747		938	1518	2456	3·8	65·4
3	8	3½	58·9	19	543	748	1291		..	..	..	3·7	72·6
4	9	3¼	57·3	23	584	807	1391		41	59	100	4·2	72·4
5A	11	0¾	57·4	27	668	872	1540		125	124	249	4·2	76·6
5B	12	0½	56·8	21	708	892	1600		165	144	309	3·0	79·4
6A	14	2¾	59·6	28	904	1172	2076		361	424	785	3·2	77·1
6B	14	1½	56·7	33	847	1179	2026		304	431	735	4·1	71·9
7A	20	2½	59·1	40	1259	1983	3242		716	1235	1951	3·3	63·5
7B	19	0¼	59·3	34	1167	1687	2854		624	939	1563	3·0	69·2
8A	27	0¾	59·4	49	1665	2477	4142		1122	1729	2851	3·1	67·2
8B	22	1	59·0	42	1354	2010	3364		811	1262	2073	3·2	67·4
9A	40	0½	57·9	60	2383	3852	6235		1840	3104	4944	2·6	61·9
9B	27	2¾	58·0	48	1654	2540	4194		1111	1792	2903	3·0	65·1
10A	17	0¾	57·5	43	1031	1322	2353		488	574	1062	4·4	78·0
10B	18	1	58·4	37	1105	1492	2597		562	744	1306	3·5	74·1
11A	18	3¾	60·0	45	1182	1453	2635		639	705	1344	4·0	81·4
11B	16	3¼	59·8	41	1046	1353	2399		503	605	1108	4·1	77·3
12A	19	3¼	60·2	58	1249	1640	2889		706	892	1598	4·9	76·2
12B	15	3	59·9	51	994	1331	2325		451	583	1034	5·4	75·4
13A	18	2	60·1	54	1165	1581	2746		622	833	1455	4·9	73·7
13B	18	0	60·1	29	1108	1556	2664		565	808	1373	2·7	71·2
14A	19	0¼	59·5	35	1170	1633	2803		627	885	1512	3·1	71·6
14B	18	0	57·2	34	1063	1503	2566		520	755	1275	3·4	70·8
15A	32	3¼	58·9	44	1978	2817	4795		1435	2069	3504	2·3	70·0
15B	33	1¾	59·6	44	2036	2759	4795		1493	2011	3504	2·2	73·8
16A	10	1	57·2	24	610	736	1346		67	− 12	55	4·1	82·8
16B	9	1½	58·9	15	567	767	1334		24	19	43	2·6	73·9
17A	10	0¼	59·1	69	662	823	1485		119	75	194	11·7	80·4
17B	9	3¼	58·6	15	591	728	1319		48	− 20	28	2·6	81·2
18A	11	2¾	58·0	17	696	1038	1734		153	290	443	2·5	67·1
18B	13	2	58·8	21	816	1090	1906		273	342	615	2·7	74·9
19	19	1¾	58·0	28	1156	1452	2608		613	704	1317	2·5	79·6
20	11	1½	58·1	33	694	994	1688		151	246	397	5·0	69·8
21	11	2½	58·5	30	710	1049	1759		167	301	468	4·5	67·7
22	21	0¼	55·0	38	1197	1725	2922		654	977	1631	3·2	69·4

Appendix-Table XVI.—Produce of the 35th Season, 1877–8. Seed (Red Rostock) sown November 2 and 3; Crop cut August 1–10, and carted August 19.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.) Dressed Grain. Quantity.		Weight per Bushel.	Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Increase per Acre by Manure. Grain.	Straw and Chaff.	Total Produce.	Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	15	2	59·0	44	959	1420	2379	183	339	522	4·8	67·5
1	10	1½	59·1	41	654	1064	1718	−122	−17	−139	6·6	61·4
2	28	1	60·9	170	1890	4042	5932	1114	2961	4075	9·9	46·7
3	12	1¼	59·0	50	776	1081	1857	..	..	..	6·9	71·8
4	12	1¾	59·9	30	776	992	1768	none	−89	−89	4·0	78·3
5A	14	3	58·3	41	899	1324	2223	123	243	366	4·8	67·9
5B	14	2½	59·3	36	901	1320	2221	125	239	364	4·2	68·3
6A	22	1	61·1	64	1424	2813	4237	648	1732	2380	4·7	50·6
6B	23	0¾	60·5	64	1468	3074	4542	692	1993	2685	4·6	47·8
7A	30	1¼	60·6	159	1998	4804	6802	1222	3723	4945	8·7	41·6
7B	32	0¾	60·6	180	2132	5100	7232	1356	4019	5375	9·2	43·8
8A	37	3½	60·4	165	2452	6227	8679	1676	5146	6822	7·2	39·4
8B	38	1½	60·2	175	2485	6119	8604	1709	5038	6747	7·6	40·6
9A	37	0¾	59·2	131	2333	5624	7957	1557	4543	6100	5·9	41·5
9B	23	1½	56·9	78	1408	2897	4305	632	1816	2448	5·9	48·6
10A	27	1½	59·5	78	1708	2762	4470	932	1681	2613	4·8	61·9
10B	29	3¼	59·6	75	1853	2981	4834	1077	1900	2977	4·2	62·1
11A	29	2¼	59·9	124	1894	4258	6152	1118	3177	4295	7·0	44·5
11B	29	2½	60·0	126	1903	4326	6229	1127	3245	4372	7·1	44·0
12A	28	3	60·5	168	1906	4479	6385	1130	3398	4528	9·7	42·6
12B	29	2½	60·8	165	1966	4824	6790	1190	3743	4933	9·1	40·7
13A	29	0	61·1	115	1888	4708	6596	1112	3627	4739	6·5	40·1
13B	29	3¾	60·6	103	1917	4664	6581	1141	3583	4724	5·7	41·1
14A	32	2	60·8	107	2085	5014	7099	1309	3933	5242	5·4	41·6
14B	31	2½	60·3	86	1994	4794	6788	1218	3713	4931	4·5	41·6
15A	20	3¾	59·6	85	1334	2931	4265	558	1850	2408	6·8	45·5
15B	23	0¾	60·1	102	1495	3211	4706	719	2130	2849	7·3	46·5
16A	13	3¾	59·3	35	862	1351	2213	86	270	356	4·2	63·8
16B	13	0¾	60·3	43	837	1312	2149	61	231	292	5·5	63·8
17A	29	1½	61·0	122	1914	4528	6442	1138	3447	4585	6·8	42·3
17B	28	2½	60·8	94	1834	4735	6569	1058	3654	4712	5·4	38·7
18A	15	0¼	59·8	54	955	1514	2469	179	433	612	6·0	63·1
18B	15	1½	60·2	50	976	1596	2572	200	515	715	5·4	61·2
19	27	1¾	60·0	77	1723	3148	4871	947	2067	3014	4·7	54·7
20	14	1	57·7	41	863	1212	2075	87	131	218	5·0	71·2
21	19	1½	59·3	60	1208	1821	3029	432	740	1172	5·2	66·3
22	18	2¾	59·0	62	1163	1880	3043	387	799	1186	5·6	61·9

APPENDIX-TABLE XVII.—PRODUCE of the 36th SEASON, 1878–9. SEED (RED ROSTOCK) sown OCTOBER 30 and 31, 1878; CROP cut SEPTEMBER 4–17, and carted SEPTEMBER 22.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pcks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	4	2¾	54·0	65	318	691	1009	− 12	− 72	− 84	25·7	46·0
1	2	2¼	54·0	44	182	428	610	−148	−335	−483	31·9	42·5
2	16	0	56·8	153	1064	2239	3303	734	1476	2210	16·8	47·5
3	4	2¾	52·5	84	330	763	1093	..	..	..	34·0	43·3
4	4	1½	51·1	92	317	748	1065	− 13	− 15	− 28	41·2	42·4
5A	5	3	53·9	75	385	841	1226	55	78	133	24·2	45·8
5B	5	2¼	53·0	87	382	868	1250	52	105	157	29·3	44·0
6A	9	1¼	56·2	96	619	1400	2019	289	637	926	18·4	44·2
6B	11	2¾	56·7	100	762	1784	2546	432	1021	1453	15·1	42·7
7A	15	1	56·5	108	969	2890	3859	639	2127	2766	12·5	33·5
7B	17	1	56·8	153	1133	3133	4266	803	2370	3173	15·6	36·2
8A	20	0½	56·7	177	1318	4069	5387	988	3306	4294	15·5	32·4
8B	21	0	56·2	206	1384	4283	5667	1054	3520	4574	17·5	32·3
9A	21	3¾	56·5	222	1462	4347	5809	1132	3584	4716	17·9	33·6
9B	4	2¼	49·8	119	345	1070	1415	15	307	322	52·5	32·3
10A	3	3¾	48·9	80	272	889	1161	− 58	126	68	41·4	30·5
10B	4	2½	52·6	125	370	1006	1376	40	243	283	51·1	36·7
11A	11	0¾	55·5	168	788	2086	2874	458	1323	1781	27·1	37·8
11B	11	0½	53·6	81	676	1955	2631	346	1192	1538	13·6	34·5
12A	13	3¼	56·4	132	913	2555	3468	583	1792	2375	16·9	35·7
12B	14	1	55·3	164	952	2384	3336	622	1621	2243	20·8	39·9
13A	14	0¾	57·5	148	964	2776	3740	634	2013	2647	18·1	34·7
13B	17	3½	58·0	151	1188	3327	4515	858	2564	3422	14·6	35·7
14A	16	3	57·7	140	1105	3072	4177	775	2309	3084	14·5	36·0
14B	15	2¾	56·6	200	1089	2734	3823	759	1971	2730	22·5	39·8
15A	5	3½	53·1	93	406	1019	1425	76	256	332	29·8	39·8
15B	4	3¾	52·5	73	333	792	1125	3	29	32	28·2	42·1
16A	5	1¼	52·8	80	359	808	1167	29	45	74	28·7	44·5
16B	4	1¼	52·9	92	321	819	1140	−9	56	47	40·3	39·2
17A	2	2½	52·5	52	189	589	778	−141	−174	−315	38·1	32·0
17B	3	2½	49·5	75	255	659	914	− 75	−104	−179	41·8	38·6
18A	19	3¼	58·7	121	1284	3283	4567	954	2520	3474	10·4	39·1
18B	20	3½	57·9	123	1330	3406	4736	1000	2643	3643	10·2	39·1
19	8	0¾	53·6	135	573	1335	1908	243	572	815	30·7	42·9
20	4	1	53·0	71	296	745	1041	− 34	− 18	− 52	31·6	39·7
21	8	1½	54·0	90	541	1138	1679	211	375	586	19·9	47·6
22	11	3¼	55·5	106	761	1798	2559	431	1035	1466	16·2	42·3

Appendix-Table XVIII.—Produce of the 37th Season, 1879–80. Seed (Red Rostock) sown October 27 and 28, 1879; Crop cut August 14–20, and carted August 25.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.) Dressed Grain. Quantity.		Weight per Bushel.	Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Increase per Acre by Manure. Grain.	Straw and Chaff.	Total Produce.	Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	bush.	pks.	lbs,	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	16	0¾	58·6	41	990	1315	2305	301	166	467	4·3	75·3
1	11	0	57·6	21	655	1151	1806	– 34	2	– 32	3·3	56·9
2	38	1¼	60·2	66	2373	3902	6275	1684	2753	4437	2·8	60·8
3	11	2	56·9	34	689	1149	1838	..	..	..	5·1	59·9
4	12	3	57·4	27	760	1263	2023	71	114	185	3·6	60·2
5A	18	2¼	59·1	33	1128	1747	2875	439	598	1037	3·0	64·6
5B	16	3¼	59·2	43	1038	1722	2760	349	573	922	4·3	60·3
6A	27	3	59·8	59	1718	3172	4890	1029	2023	3052	3·6	54·2
6B	26	0¼	59·8	51	1610	2649	4259	921	1500	2421	3·3	60·8
7A	34	2½	59·7	82	2149	4051	6200	1460	2902	4362	4·0	53·0
7B	34	1¼	59·9	94	2149	3960	6109	1460	2811	4271	4·6	54·3
8A	37	2¾	59·6	127	2374	5135	7509	1685	3986	5671	5·6	46·2
8B	32	3½	58·5	106	2031	3817	5848	1342	2668	4010	5·5	53·2
9A	34	0¼	57·8	165	2130	4394	6524	1441	3245	4686	8·4	48·4
9B	10	1¾	53·5	95	654	1420	2074	– 35	271	236	17·0	46·1
10A	10	2½	54·9	62	645	1242	1887	– 44	93	49	10·6	51·9
10B	13	1¾	53·5	60	779	1631	2410	90	482	572	8·3	47·7
11A	27	0¼	58·4	94	1673	2868	4541	984	1719	2703	6·0	58·3
11B	24	2	57·3	117	1520	2835	4355	831	1686	2517	8·3	53·6
12A	30	3	59·2	101	1921	3589	5510	1232	2440	3672	5·5	53·5
12B	27	3½	58·7	104	1739	2939	4678	1050	1790	2840	6·4	59·2
13A	33	0½	59·9	85	2070	3859	5929	1381	2710	4091	4·3	53·7
13B	32	3¼	59·4	78	2029	3649	5678	1340	2500	3840	4·0	55·6
14A	32	1	59·2	98	2007	3638	5645	1318	2489	3807	5·2	55·2
14B	29	2¾	57·8	96	1811	3009	4820	1122	1860	2982	5·6	60·2
15A	36	3½	60·8	82	2325	4234	6559	1636	3085	4721	3·6	54·9
15B	35	1¾	60·7	89	2242	3816	6058	1553	2667	4220	4·1	58·7
16A	14	2½	58·1	33	882	1736	2618	193	587	780	3·9	50·8
16B	14	0¾	58·5	56	885	1263	2148	196	114	310	6·8	70·1
17A	32	0	60·7	75	2017	3383	5400	1328	2234	3562	3·8	59·6
17B	33	2¼	59 5	88	2083	3271	5354	1394	2122	3516	4·5	63·7
18A	14	2½	58·1	51	903	1340	2243	214	191	405	6·0	67·4
18B	15	1¼	57·7	53	935	1351	2286	246	202	448	6·0	69·2
19	32	2	58·4	157	2057	3254	5311	1368	2105	3473	8·2	63·2
20–1	20	3¼	60·0	65	1314	2120	3434	625	971	1596	5·2	62·0
20–2	12	3	56·6	49	771	1096	1867	82	– 53	29	6·8	70·3
21	16	2	57·3	46	992	1626	2618	303	477	780	4·8	61·0
22	26	1¾	57·3	66	1581	2469	4050	892	1320	2212	4·4	64·0

Appendix-Table XIX.—Produce of the 38th Season, 1880–1. Seed (Red Rostock) sown October 25, 1880; Crop cut August 8–11, and carted August 29, and September 1.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.)							Increase per Acre by Manure.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	15	2½	54·2	63	909	973	1882	46	−173	−127	7·5	93·4
1	12	2¾	53·7	45	728	794	1522	−135	−352	−487	6·6	91·6
2	30	0¾	58·9	130	1907	2367	4274	1044	1221	2265	7·3	80·6
3	13	3	58·0	64	863	1146	2009	..	..	..	8·1	75·4
4	12	2¼	57·1	41	758	833	1591	−105	−313	−418	5·8	91·0
5A	12	3	58·0	68	806	909	1715	− 57	−237	−294	9·2	88·6
5B	12	2½	57·8	75	805	897	1702	− 58	−249	−307	10·3	89·7
6A	21	1¼	57·6	105	1333	1595	2928	470	449	919	8·6	83·6
6B	22	0	57·9	110	1383	1663	3046	520	517	1037	8·6	83·2
7A	27	0¾	58·4	150	1738	2269	4007	875	1123	1998	9·5	76·6
7B	26	0½	59·1	145	1690	2137	3827	827	991	1818	9·4	79·1
8A	32	2	59·1	166	2086	3169	5255	1223	2023	3246	8·7	65·9
8B	28	3¼	59·1	136	1837	2643	4480	974	1497	2471	8·0	69·5
9A	35	1¾	58·4	203	2271	3640	5911	1408	2494	3902	9·8	62·4
9B	22	3	58·5	95	1424	1817	3241	561	671	1232	7·1	78·4
10A	18	0¾	58·4	106	1168	1297	2465	305	151	456	10·0	90·0
10B	19	3	57·5	125	1259	1399	2658	396	253	649	11·0	90·0
11A	21	3¾	56·2	145	1378	1642	3020	515	496	1011	11·8	83·9
11B	21	0	56·4	170	1352	1552	2904	489	406	895	14·4	87·1
12A	25	2½	55·0	118	1525	1884	3409	662	738	1400	8·4	81·0
12B	21	3¼	55·5	143	1352	1885	3237	489	739	1228	11·8	71·8
13A	28	2½	55·8	140	1737	2319	4056	874	1173	2047	8·8	74·9
13B	27	3¼	55·3	157	1694	2220	3914	831	1074	1905	10·2	76·3
14A	28	2½	55·7	143	1737	2276	4013	874	1130	2004	8·9	76·3
14B	26	0¾	55·3	132	1580	2103	3683	717	957	1674	9·1	75·1
15A	25	2	55·9	109	1535	1917	3452	672	771	1443	7·7	80·1
15B	25	0¼	55·9	100	1500	2025	3525	637	879	1516	7·2	74·1
16A	13	1¼	56·1	64	809	911	1720	− 54	−235	−289	8·6	88·9
16B	13	2½	55·1	47	799	953	1752	− 64	−193	−257	6·3	83·8
17A	13	3½	55·4	56	826	926	1752	− 37	−220	−257	7·3	89·1
17B	12	2	55·1	70	758	878	1636	−105	−268	−373	10·2	86·4
18A	31	1¾	55·7	151	1904	2533	4437	1041	1387	2428	8·6	75·1
18B	32	2	55·5	87	1892	2577	4469	1029	1431	2460	4·8	73·4
19	24	2¾	56·4	146	1538	1815	3353	675	669	1344	10·5	84·7
20–1	23	2	55·3	112	1410	1770	3180	547	624	1171	8·7	79·7
20–2	15	1½	56·4	55	921	1006	1927	58	−140	− 82	6·3	91·6
21	11	3½	54·6	60	709	715	1424	−154	−431	−585	9·3	99·1
22	10	3½	53·6	54	638	636	1274	−225	−510	−735	9·3	100·4

APPENDIX-TABLE XX.—PRODUCE of the 39th SEASON, 1881–2. SEED (SQUARE HEAD) sown OCTOBER 31, and NOVEMBER 1 and 2, 1881; CROP cut AUGUST 10–16, and carted AUGUST 24.

PLOTS.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.							Increase per Acre by Manures.			Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	Dressed Grain.			Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Grain.	Straw and Chaff.	Total Produce.		
	Quantity.		Weight per Bushel.									
	bush.	pks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs		
0	13	0¾	61·0	44	846	1284	2130	167	189	356	5·5	65·9
1	9	1¾	60·1	36	605	1109	1714	−74	14	−60	6·2	54·5
2	32	2¾	59·6	57	2004	3993	5997	1325	2898	4223	2·9	50·2
3	10	3¾	58·7	38	679	1095	1774	..	..	..	5·9	62·0
4	10	3½	57·8	69	698	1017	1715	19	−78	−59	10·9	68·6
5A	12	3¾	58·4	37	793	1317	2110	114	222	336	4·9	60·2
5B	12	0	58·5	56	760	1244	2004	81	149	230	7·9	61·1
6A	23	1¼	60·7	48	1466	2897	4363	787	1802	2589	3·4	50·6
6B	22	3½	60·8	77	1468	2940	4408	789	1845	2634	5·6	49·9
7A	36	3¼	60·2	89	2304	5819	8123	1625	4724	6349	4·1	39·6
7B	34	3	59·7	121	2198	5641	7839	1519	4546	6065	5·8	39·0
8A	36	0¾	59·2	162	2303	7413	9716	1624	6318	7942	7·6	31·1
8B	37	3¼	59·0	113	2343	6806	9149	1664	5711	7375	5·1	34·4
9A	31	3¼	59·8	108	2012	6274	8286	1333	5179	6512	5·7	32·1
9B	24	1¼	58·0	111	1520	3617	5137	841	2522	3363	7·9	42·0
10A	23	2¾	60·7	120	1557	2796	4353	878	1701	2579	8·3	55·7
10B	26	0¼	60·6	92	1672	3012	4684	993	1917	2910	5·8	55·5
11A	30	3¼	61·1	132	2015	3921	5936	1336	2826	4162	7·0	51·4
11B	29	3½	61·2	126	1951	3805	5756	1272	2710	3982	6·9	51·3
12A	34	1¼	60·8	133	2221	4938	7159	1542	3843	5385	6·4	45·0
12B	34	3¾	61·2	81	2222	4636	6858	1543	3541	5084	3·8	47·9
13A	32	2¼	62·1	82	2105	4918	7023	1426	3823	5249	4·1	42·8
13B	31	3	61·5	96	2048	4865	6913	1369	3770	5139	4·9	42·1
14A	35	3¾	60·1	75	2235	4949	7184	1556	3854	5410	3·5	45·2
14B	33	1¾	60·5	110	2134	4570	6704	1455	3475	4930	5·4	46·7
15A	29	1¾	61·4	64	1871	4216	6087	1192	3121	4313	3·6	44·4
15B	28	1½	61·0	96	1827	3981	5808	1148	2886	4034	5·6	45·9
16A	11	0	58·4	55	698	1293	1991	19	198	217	8·5	54·0
16B	10	2¼	58·0	40	655	1204	1859	−24	109	85	6·6	54·4
17A	30	1	61·5	113	1971	4127	6098	1292	3032	4324	6·1	47·8
17B	31	3¼	61·7	59	2004	4186	6190	1325	3091	4416	3·0	47·9
18A	14	3¼	59·3	41	921	1497	2418	242	402	644	4·7	61·5
18B	16	1½	61·4	47	1052	1587	2639	373	492	865	4·7	66·3
19	30	1	61·7	82	1949	3458	5407	1270	2363	3633	4·4	56·4
20–1	18	1¼	61·3	80	1203	2045	3248	524	950	1474	7·1	58·8
20–2	15	2¼	61·3	40	993	1346	2339	314	251	565	4·2	73·7
21	15	1¼	60·5	54	979	1618	2597	300	523	823	5·8	60·4
22	11	2	60·2	33	725	1285	2010	46	190	236	4·7	56·4

Appendix-Table XXI.—Produce of the 40th Season, 1882–3. Seed (Square Head) sown November 6 and 9, 1882; Crop cut August 13–23, and carted August 24–27.

Plots.	Produce per Acre, &c. (For the Manures, see pp. 1 and 2.) Dressed Grain. Quantity.		Weight per Bushel.	Offal Grain.	Total Grain.	Straw and Chaff.	Total Produce (Grain and Straw).	Increase per Acre by Manure. Grain.	Straw and Chaff.	Total Produce.	Offal Grain to 100 Dressed.	Total Grain to 100 Straw.
	bush.	pks.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
0	15	0¾	61·7	43	980	997	1977	108	− 9	99	4·6	98·3
1	11	0½	61·6	25	712	783	1495	−160	−223	−383	3·7	90·9
2	35	0¾	62·4	49	2244	2930	5174	1372	1924	3296	2·2	76·6
3	13	3¼	61·2	28	872	1006	1878	..	..	..	3·3	86·7
4	13	1¼	61·2	23	837	978	1815	− 35	− 28	− 63	2·9	85·6
5A	15	2	61·8	35	994	1101	2095	122	95	217	3·6	90·3
5B	15	3½	62·0	37	1023	1175	2198	151	169	320	3·8	87·0
6A	27	2	62·1	50	1756	2655	4411	884	1649	2533	2·9	66·2
6B	27	3	63·4	50	1806	2554	4360	934	1548	2482	2·8	70·7
7A	35	3½	62·7	107	2357	3657	6014	1485	2651	4136	4·8	64·4
7B	36	1¼	63·1	107	2399	3607	6006	1527	2601	4128	4·7	66·5
8A	43	0¾	63·4	137	2871	4654	7525	1999	3648	5647	5·0	61·7
8B	40	1¾	63·5	125	2695	3928	6623	1823	2922	4745	4·9	68·6
9A	43	1½	62·1	213	2905	5127	8032	2033	4121	6154	7·9	56·7
9B	19	0½	59·6	195	1337	1684	3021	465	678	1143	17·1	79·4
10A	17	2	60·4	141	1196	1419	2615	324	413	737	13·3	84·3
10B	18	1¼	61·0	162	1280	1524	2804	408	518	926	14·5	84·0
11A	27	3	61·7	129	1842	2466	4308	970	1460	2430	7·6	74·7
11B	25	0¼	60·6	106	1625	2158	3783	753	1152	1905	7·0	75·3
12A	31	1½	63·1	131	2110	2854	4964	1238	1848	3086	6·6	73·9
12B	30	0¼	62·3	104	1977	2668	4645	1105	1662	2767	5·6	74·1
13A	34	1	63·7	115	2297	3504	5801	1425	2498	3923	5·3	65·6
13B	33	3½	62·2	86	2196	3225	5421	1324	2219	3543	4·9	68·1
14A	34	0	62·3	144	2263	3128	5391	1391	2122	3513	6·8	72·3
14B	32	3	62·1	127	2162	2941	5103	1290	1935	3225	6·2	73·5
15A	33	0½	62·7	124	2202	3227	5429	1330	2221	3551	6·0	68·2
15B	32	3¼	62·3	119	2164	3279	5443	1292	2273	3565	5·8	66·0
16A	15	1½	62·8	44	1008	1063	2071	136	57	193	4·5	94·8
16B	16	1	62·1	37	1045	1146	2191	173	140	313	3·6	91·2
17A	15	2¾	62·4	55	1033	1153	2186	161	147	308	5·6	89·6
17B	15	2	62·3	34	999	1168	2167	127	162	289	3·5	85·5
18A	37	2¾	62·6	52	2411	3932	6343	1539	2926	4465	2·2	61·3
18B	38	3	62·5	48	2470	3766	6236	1598	2760	4358	2·0	65·6
19	30	2½	62·7	63	1986	2759	4745	1114	1753	2867	3·3	72·0
20–1	31	0	62·0	135	2058	2887	4945	1186	1881	3067	7·0	71·3
20–2	17	0¼	61·2	54	1099	1110	2209	227	104	331	5·2	99·0
21	16	1	62·0	46	1054	1302	2356	182	296	478	4·6	80·9
22	12	2	62·4	35	816	887	1703	− 56	−119	−175	4·5	92·0

APPENDIX-TABLE XXII.—DRESSED GRAIN

PLOTS.	HARVESTS. 1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.
0	19 0	15 2	16 3	10 2½	22 1¼	15 1¼	21 2¾	13 3¾	17 1	15 2¼	16 3½	10 1
1	14 3¾	12 1½	11 1¾	7 3¼	20 2¼	12 0¾	16 0¾	10 1¼	10 3½	10 2	11 1½	8 0
2	40 0	37 0½	32 2½	27 2¼	41 3	38 1	36 2	38 3¾	32 1½	26 3	39 1	28 3
3	16 1¾	13 1¼	12 0½	8 3½	16 2½	14 1	14 3¾	9 1¼	10 2¾	11 2¾	11 1¾	8 2
4	17 0¼	14 2¾	13 1½	9 1	17 2	14 3¼	15 2¾	10 1¼	11 1¼	12 0½	12 1	7 2
5A	16 1	14 0¾	13 0½	9 2½	16 1¼	15 2¼	18 0¾	11 0	12 3¾	12 3½	12 2¼	8 1
5B	17 2	14 0¾	13 1½	8 3½	18 3½	15 3½	19 0¾	12 3	12 2½	12 2	13 1¾	10 0
6A	31 1½	24 3¼	19 3½	15 1¼	27 3	21 0½	29 3	16 3¾	20 3¼	14 3¼	25 2¾	15 3
6B	30 3¼	25 0	21 0¼	16 0¾	28 3¾	22 0¼	31 0½	17 0	20 0¾	16 3¾	25 3½	16 3
7A	44 1¼	40 0	30 0¼	22 3¾	40 2	28 2¼	39 2¾	22 0¾	30 1¼	21 0½	39 1¼	25 0
7B	47 1	40 1¾	29 3	21 1½	39 0¾	28 1	41 1½	22 1¼	29 0¼	22 3	39 2¼	26 2
8A	49 3	43 3½	32 0	29 1½	44 0½	35 0¼	45 3¾	26 1	37 0¼	25 3¾	41 3½	31 0
8B	50 0	43 1¼	32 1	31 1¾	48 3½	34 1¾	44 2	29 0½	34 0¼	29 0¼	39 0½	28 2
9A	51 0¼	44 0¼	32 2	29 0½	47 3¼	39 0	45 2	34 1¾	40 2¾	35 3¼	38 0¾	30 2
9B	33 1	29 2¼	30 3	22 0½	27 1	24 0½	26 1¾	17 2½	23 1½	21 3¼	21 2	16 2
10A	32 0¼	25 0¾	26 1	18 0½	24 3	20 1	21 2¾	10 0½	18 0	19 2½	25 1	12 3
10B	36 0¾	30 1¾	28 2	19 1½	27 2¾	19 0½	23 0¾	10 0	18 2¾	20 2½	27 0¾	14 2
11A	34 2	26 2¼	27 3½	21 3¾	33 1¾	24 0¼	25 0½	12 0¼	27 0	19 0½	36 2	19 [illegible]
11B	38 1½	28 0¼	28 0½	22 1	33 2½	20 1½	25 1¾	9 3½	27 1¾	19 1¾	29 1	15 [illegible]
12A	44 1¾	35 0¾	28 1½	25 0½	39 2	26 1¾	36 2	22 2¾	30 0	22 1¾	40 3¾	24 [illegible]
12B	44 3	33 3¾	28 0¾	23 3¾	40 1	28 0¼	34 0	19 1¾	28 2	23 1½	38 0	25 [illegible]
13A	42 2¾	35 3	24 0¾	23 1½	37 3¼	25 2¾	35 2¼	28 1	30 1¼	22 3½	36 3	26 [illegible]
13B	43 2¾	38 2	25 1¼	24 1	40 2½	28 3½	38 1½	32 0¼	29 2	24 0	37 1¾	27 [illegible]
14A	41 0¼	36 0¼	28 1½	23 0¾	41 3¾	28 1	35 0½	26 2¼	31 0¾	23 3¾	37 3¼	27 [illegible]
14B	41 3¾	37 0¼	27 2¼	22 1¼	41 1¾	27 0½	36 1	21 3¾	29 1¾	24 1	35 1½	25 [illegible]
15A	37 2¼	35 1¾	26 0	22 3½	44 0½	26 2¼	38 0¾	29 1¼	30 0¼	32 3¼	27 3	23 [illegible]
15B	37 1	36 1	26 1½	23 0½	41 2¼	27 0½	38 2½	32 0¼	32 1¼	32 1¼	30 2½	27 [illegible]
16A	50 3½	32 0	17 0½	14 1½	23 0	16 1¾	18 1¼	13 1	13 3¼	12 2¼	9 0¼	10 [illegible]
16B	51 1½	32 2½	17 2	14 3¼	22 2¼	15 3¼	18 0¾	13 3	12 1¾	13 0	14 2½	9 [illegible]
[3] 17A	36 2¼	16 3½	27 0¾	10 3½	38 0¼	15 1	33 1½	13 1½	25 3	10 2½	32 3¼	11 [illegible]
17B	35 3¼	17 0¾	25 2½	10 2¾	36 3	17 0	35 1	18 2	26 0¼	12 3¼	33 2½	12 [illegible]
18A	17 0¼	30 0½	12 0¾	22 3	18 0¾	23 0¼	17 3	28 0¼	12 1¾	19 2	13 3	25 [illegible]
18B	18 1¼	32 3	13 0¾	24 1¾	19 0¾	22 3¼	20 1	28 3	13 1¾	21 0½	14 0½	25 [illegible]
19	37 0½	32 3½	26 2¼	23 3¾	36 3¾	23 0¾	32 1	22 1¼	27 2¾	20 0	37 3¼	22 [illegible]
20	13 2	13 2¾	13 2½	7 0¾	..[5]	13 0¾	14 2¾	10 1¾	11 1½	12 2	13 3	8 [illegible]
21	24 3¼	18 1¼	17 2	12 2¼	26 1	20 2½	25 3	15 0¾	20 3¼	14 0¼	22 3½	12 [illegible]
22	25 1½	19 0¾	18 1¾	12 2¾	24 3¾	15 0¾	26 2¼	16 3	20 0¼	18 0¼	21 1½	13 [illegible]

[1] Average of 9 years, 1865–73. See note ([5]) to Appendix-Table I., p. 2. [2] Average
17A and 17B, are those of 10, 10 and 20 years mineral manure succeeding ammonia-sa
ammonia-salts succeeding the mineral manure (Plots 17A and 17B, or 18A and 18B.) [5] Prod
Appendix-Table I., p. 2. [7] Average of 9 years 1864–7 and 1869–73. [8] Average of 19 ye

in Bushels and Pecks, per Acre, per Annum.

Harvests.								Average.			Plots.
1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	Of 10 Years, 1864–73.	Of 10 Years, 1874–83.	Of 20 Years, 1864–83.	
bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bsh. pks.	bush. pks.	bush. pks.	bush. pcks.	
11 3½	11 3¾	15 2	4 2¾	16 0¾	15 2½	13 0¾	15 0¾	16 3¼	13 0½	14 3¾	0
7 2	7 0¼	10 1½	2 2¼	11 0	12 2¾	9 1¾	11 0½	12 3	9 0¼	10 3¾	1
23 3¼	24 0½	28 1	16 0	38 1¼	30 0¾	32 2¾	35 0¾	35 0¾	29 2¾	32 1¾	2
8 0½	8 3½	12 1¼	4 2¾	11 2	13 3	10 3¾	13 3¼	12 3¼	10 1¾	11 2½	3
9 0	9 3¼	12 1¾	4 1½	12 3	12 2¼	10 3½	13 1¼	13 2½	10 2	12 0¼	4
9 3¾	11 0¾	14 3	5 3	18 2¼	12 3	12 3¾	15 2	14 0	12 0¾	13 0½	5A
11 0¼	12 0½	14 2½	5 2¼	16 3¼	12 2½	12 0	15 3½	14 2¼	12 1¾	13 2	5B
14 3½	14 2¾	22 1	9 1¼	27 3	21 1¼	23 1¼	27 2	22 1	20 1	21 1	6A
16 2	14 1½	23 0¾	11 2¾	26 0¼	22 0	22 3½	27 3	22 3¾	20 2¾	21 3¼	6B
21 1¾	20 2½	30 1¼	15 1	34 2½	27 0¾	36 3¼	35 3½	31 3¾	28 2¾	30 1¼	7A
25 2	19 0½	32 0¾	17 1	34 1¼	26 0½	34 3	36 1¼	32 0¾	29 0½	30 2¾	7B
30 2¾	27 0¾	37 3½	20 0½	37 2¾	32 2	36 0¾	43 0¾	36 3¾	33 3½	35 1½	8A
28 2	22 1	38 1½	21 0	32 3½	28 3¼	37 3¼	40 1¾	37 2¾	31 3¼	34 3	8B
33 1¼	40 0½	37 0¾	21 3¾	34 0¼	35 1¾	31 3¼	43 1½	40 0	34 2½	37 1¼	9A
13 0	27 2¾	23 1½	4 2¼	10 1¾	22 3	24 1¼	19 0½	25 2½	18 1¼	22 0	9B
12 0½	17 0¾	27 1½	3 3¾	10 2½	18 0¾	23 2¾	17 2	21 2½	16 3½	19 1	10A
14 1¾	18 1	29 3¼	4 2½	13 1¾	19 3	26 0¼	18 1¼	23 1½	18 2½	21 0	10B
15 1	18 3¾	29 2¼	11 0¾	27 0¼	21 3¾	30 3¼	27 3	25 0¾	23 3½	24 2¼	11A
13 1¾	16 3¼	29 2½	11 0½	24 2	21 0	29 3½	25 0¼	25 1¼	21 2½	23 2	11B
19 2¼	19 3¼	28 3	13 3¼	30 3	25 2½	34 1¼	31 1½	31 0¼	27 0	29 0	12A
18 3	15 3	29 2½	14 1	27 3½	21 3¼	34 3¾	30 0¼	30 1¾	25 2¾	28 0¼	12B
24 2	18 2	29 0	14 0¾	33 0½	28 2½	32 2¼	34 1	30 2½	27 3¼	29 0¾	13A
25 3¼	18 0	29 3¾	17 3½	32 3¼	27 3¼	31 3	33 3½	32 2	28 1¼	30 1¾	13B
22 3½	19 0¼	32 2	16 3	32 1	28 2½	35 3¾	34 0	31 2¼	28 3	30 0½	14A
21 1	18 0	31 2½	15 2¾	29 2¾	26 0¾	33 1¾	32 3	30 3¾	26 3½	28 3¾	14B
24 3	32 3¼	20 3¾	5 3½	36 3½	25 2	29 1¾	33 0½	32 1¼	26 0¼	29 0¾	15A
26 0½	33 1¾	23 0¾	4 3¾	35 1¾	25 0¼	28 1½	32 3¼	32 2¾	26 3	29 3	15B
10 3¾	10 1	13 3¾	5 1¼	14 2½	13 1¼	11 0	15 1½	17 3½ [1]	11 1¾	14 2 [2]	16A
11 0¼	9 1½	13 0¾	4 1¼	14 0¾	13 2½	10 2¼	16 1	17 3½	11 2¾	14 2½	16B
27 0	10 0¼	29 1½	2 2½	32 0	13 3½	30 1	15 2¾	14 1¾ [4]	12 0¾ [4]	13 1¼ [4]	17A [3]
25 3½	9 3¼	28 2½	3 2½	33 2¼	12 2	31 3¼	15 2	16 0¼	12 2¼	14 1¼	17B
10 0½	11 2¾	15 0¼	19 3¼	14 2½	31 1¾	14 3¼	37 2¾	28 1¾ [4]	27 3 [4]	28 0¼ [4]	18A
10 2½	13 2	15 1½	20 3½	15 1¼	32 2	16 1½	38 3	28 3¾	28 2	28 3	18B
19 1	19 1¾	27 1¾	8 0¾	32 2	24 2¾	30 1	30 2½	28 1¼	25 1¼	26 3¼	19
7 1½	11 1½	14 1	4 1	20 3¼	23 2	18 1¼	31 0	..	..	23 1¾ [6]	20–1
				12 3	15 1½	15 2¼	17 0¼	12 1 [7]	12 0	12 0½ [8]	20–2
10 3	11 2½	19 1½	8 1½	16 2	11 3½	15 1¼	16 1	19 2¼	14 2¼	17 0¼	21
13 0¾	21 0¼	18 2¾	11 3¼	26 1¾	10 3½	11 2	12 2	19 3	16 0½	17 3¾	22

9 years, 1865–83. [3] See Note (6) to Appendix-Table I., p. 2. [4] The averages given for Plots Plots 17A and 18B, or 18A and 18B); and those given for Plots 18A and 18B of 10, 10 and 20 years unknown, owing to a mistake at harvest. [6] Average of 4 years, 1880–83. See Note (8) to 1864–7 and 1869–83.

APPENDIX-TABLE XXIII.—WEIGHTS per BUSHEL

Plots.	Harvests.											
	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0	62·0	59·0	60·0	58·7	61·4	58·1	62·1	56·5	58·7	57·6	59·1	59·4
1	62·0	59·0	59·8	57·9	60·0	58·2	62·5	57·0	57·9	56·6	59·6	58·5
2	62·5	61·5	61·7	61·4	61·6	56·9	63·4	60·0	60·7	58·1	60·2	60·6
3	62·0	60·6	61·3	56·1	61·0	56·1	61·8	54·8	59·0	57·0	58·3	60·0
4	61·9	60·3	60·9	58·6	61·6	57·1	62·6	57·0	57·6	57·2	58·8	59·7
5A	62·1	61·0	60·8	59·7	62·2	56·8	62·6	56·4	60·2	56·8	59·1	59·2
5B	62·0	60·8	61·0	59·0	63·5	57·0	62·6	56·7	59.8	57·0	59·1	59·5
6A	62·0	61·0	61·0	60·6	62·4	57·0	63·0	56·8	60·1	57·5	59·7	60·7
6B	62·0	60·9	61·0	60·5	63·2	57·3	63·1	56·3	60·3	56·6	59·5	59·8
7A	63·0	61·6	61·1	61·3	61·5	57·7	63·3	56·0	60·4	57·0	59·9	59·9
7B	63·1	61·7	60·9	60·7	60·6	57·2	63·2	57·3	60·0	57·3	59·7	59·0
8A	63·5	61·3	60·0	60·8	62·1	57·0	63·7	57·1	60·5	57·5	60·1	58·2
8B	63·5	61·5	60·2	60·5	61·9	57·5	63·8	58·3	60·4	56·3	59·6	58·1
9A	62·6	61·1	60·6	59·9	61·1	57·1	62·7	58·6	60·0	57·1	60·4	57·9
9B	61·7	59·5	59·9	57·4	62·0	54·6	61·3	52·4	55·5	54·9	57·5	55·7
10A	61·8	59·6	61·2	57·9	61·9	54·9	60·8	53·8	56·8	56·1	56·5	54·5
10B	62·1	59·8	61·5	59·3	62·4	55·6	60·8	53·8	55·9	56·5	56·9	55·6
11A	59·7	57·2	60·8	59·1	62·4	56·2	60·8	54·3	59·5	56·0	57·9	55·5
11B	59·0	57·3	60·5	59·8	62·2	55·1	60·7	53·8	58·6	55·1	58·3	54·6
12A	62·6	60·0	61·0	60·2	63·6	58·1	62·4	56·5	60·1	56·9	59·4	58·1
12B	62·4	60·3	61·3	60·6	63·3	57·9	62·5	55·6	59·4	56·5	59·7	57·2
13A	63·2	61·1	62·0	60·8	63·0	59·3	63·7	57·6	60·3	57·4	60·6	60·4
13B	63·4	61·1	61·5	60·7	63·2	59·0	63·9	58·2	60·8	57·3	60·4	60·0
14A	63·1	60·3	61·1	59·8	63·9	58·5	63·2	57·0	59·8	57·0	59·9	59·0
14B	62·8	60·4	61·3	59·6	64·1	58·1	62·7	56·7	59·5	56·6	59·2	58·0
15A	63·1	60·9	61·6	60·2	63·8	58·1	63·8	59·0	60·5	57·7	61·3	59·9
15B	63·0	61·6	61·4	59·5	63·3	59·3	63·9	58·7	60·7	57·9	60·9	60·6
16A	63·2	61·8	61·9	59·4	62·9	58·6	63·2	57·2	59·5	57·4	60·2	59·8
16B	63·2	61·7	61·6	59·1	62·7	58·1	63·3	56·5	59·3	57·0	60·0	59·5
(3) 17A	62·6	60·9	61·3	59·2	63·4	58·1	63·6	56·0	60·8	56·6	60·6	58·9
(3) 17B	62·6	60·6	61·1	57·6	64·2	57·3	63·7	56·8	60·5	57·6	60·9	59·6
(3) 18A	61·3	60·1	60·6	59·1	62·7	58·7	63·1	58·6	59·3	57·3	58·8	59·2
(3) 18B	61·6	60·3	60·8	57·5	62·9	58·0	63·3	58·0	59·5	57·6	58·8	58·9
19	62·3	58·9	59·7	56·7	62·9	56·7	62·3	56·0	59·6	56·7	58·9	56·5
20	63·3	.. [5]	59·1	56·4	62·0	56·9	62·5	55·8	57·1	56·9	59·2	57·0
21	62·3	58·0	59·9	59·3	62·6	58·1	63·1	56·8	59·6	56·9	59·5	59·9
22	62·0	58·3	59·8	59·3	62·8	58·1	63·0	56·9	59·8	56·9	59·3	60·2

[1] Average of 9 years, 1865–73. See Note (5) to Appendix-Table I., p. 2. [2] Average of 17B, are those of 10, 10 and 20 years mineral manure succeeding ammonia-salts (Plots 17A and succeeding the mineral manure (Plots 17A and 17B, or 18A and 18B). [5] Produce unknown, p. 2. [7] Average of 9 years 1864–7 and 1869–73. [8] Average of 19 years 1864–7 and 1869–83.

of Dressed Grain; each Year.

HARVESTS.								AVERAGE.			Plots.
1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	Of 10 Years, 1864–73.	Of 10 Years, 1874–83.	Of 20 Years, 1864–83.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
57·3	59·0	59·0	54·0	58·6	54·2	61·0	61·7	59·4	58·3	58·9	0
56·8	59·3	59·1	54·0	57·6	53·7	60·1	61·6	59·1	58·0	58·6	1
62·4	59·1	60·9	56·8	60·2	58·9	59·6	62·4	60·8	60·1	60·5	2
59·0	58·9	59·0	52·5	56·9	58·0	58·7	61·2	59·0	58·3	58·6	3
58·5	57·3	59·9	51·1	57·4	57·1	57·8	61·2	59·5	57·9	58·7	4
59·2	57·4	58·3	53·9	59·1	58·0	58·4	61·8	59·9	58·4	59·2	5A
59·1	56·8	59·3	53·0	59·2	57·8	58·5	62·0	59·9	58·4	59·2	5B
61·9	59·6	61·1	56·2	59·8	57·6	60·7	62·1	60·1	59·9	60·0	6A
62·2	56·7	60·5	56·7	59·8	57·9	60·8	63·4	60·1	59·7	59·9	6B
63·2	59·1	60·6	56·5	59·7	58·4	60·2	62·7	60·3	60·0	60·2	7A
62·7	59·3	60·6	56·8	59·9	59·1	59·7	63·1	60·2	60·0	60·1	7B
63·1	59·4	60·4	56·7	59·6	59·1	59·2	63·4	60·4	59·9	60·2	8A
62·7	59·0	60·2	56·2	58·5	59·1	59·0	63·5	60·4	59·6	60·0	8B
62·7	57·9	59·2	56·5	57·8	58·4	59·8	62·1	60·1	59·3	59·7	9A
56·3	58·0	56·9	49·8	53·5	58·5	58·0	59·6	57·9	56·4	57·2	9B
57·2	57·5	59·5	48·9	54·9	58·4	60·7	60·4	58·5	56·9	57·7	10A
56·4	58·4	59·6	52·6	53·5	57·5	60·6	61·0	58·8	57·2	58·0	10B
59·6	60·0	59·9	55·5	58·4	56·2	61·1	61·7	58·6	58·6	58·6	11A
58·4	59·8	60·0	53·6	57·3	56·4	61·2	60·6	58·2	58·0	58·1	11B
61·0	60·2	60·5	56·4	59·2	55·0	60·8	63·1	60·1	59·4	59·8	12A
60·4	59·9	60·8	55·3	58·7	55·5	61·2	62·3	60·0	59·1	59·6	12B
62·1	60·1	61·1	57·5	59·9	55·8	62·1	63·7	60·8	60·3	60·6	13A
62·4	60·1	60·6	58·0	59·4	55·3	61·5	62·2	60·9	60·0	60·5	13B
61·4	59·5	60·8	57·7	59·2	55·7	60·1	62·3	60·4	59·6	60·0	14A
60·7	57·2	60·3	56·6	57·8	55·3	60·5	62·1	60·2	58·8	59·5	14B
62·3	58·9	59·6	53·1	60·8	55·9	61·4	62·7	60·9	59·6	60·3	15A
61·7	59·6	60·1	52·5	60·7	55·9	61·0	62·3	60·9	59·5	60·2	15B
58·5	57·2	59·3	52·8	58·1	56·1	58·4	62·8	60·2 } [1]	58·3	59·2 } [2]	16A
58·4	58·9	60·3	52·9	58·5	55·1	58·0	62·1	59·9 }	58·4	59·1 }	16B
61·1	59·1	61·0	52·5	60·7	55·4	61·5	62·4	59·8 } [4]	58·3 } [4]	59·0 } [4]	17A } [3]
60·6	58·6	60·8	49·5	59·5	55·1	61·7	62·3	59·8 }	58·2 }	59·0 }	17B }
58·3	58·0	59·8	58·7	58·1	55·7	59·3	62·6	60·6 } [4]	59·9 } [4]	60·2 } [4]	18A }
58·5	58·8	60·2	57·9	57·7	55·5	61·4	62·5	60·4 }	59·7 }	60·0 }	18B }
57·6	58·0	60·0	53·6	58·4	56·4	61·7	62·7	59·2	58·4	58·8	19
7·3	58·1	57·7	53·0	60·0	55·3	61·3	62·0	..	..	59·7 [6]	20–1
				56·6	56·4	61·3	61·2	58·7 [7]	57·8	58·2 [8]	20–2
7·4	58·5	59·3	54·0	57·3	54·6	60·5	62·0	59·7	58·3	59·0	21
7·0	55·0	59·0	55·5	57·3	53·6	60·2	62·4	59·7	58·0	58·9	22

years, 1865–83. [3] See Note to Appendix-Table I., p. 2. [4] The averages given for Plots 17A and
B, or 18A and 18B); and those given for Plots 18A and 18B of 10, 10 and 20 years ammonia-salts
ing to a mistake at harvest. [6] Average of 4 years, 1880–83. See Note ([8]) to Appendix-Table I.

APPENDIX-TABLE XXIV.—TOTAL GRAI

PLOTS.	HARVESTS.											
	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0	1241	993	1033	664	1404	955	1415	889	1060	950	1014	663
1	962	802	709	487	1259	744	1056	685	701	636	690	511
2	2595	2384	2070	1755	2604	2256	2359	2498	2046	1622	2431	1890
3	1078	828	777	532	1054	848	956	615	705	701	694	567
4	1085	950	852	583	1103	896	1023	708	717	749	734	508
5A	1052	910	832	609	1044	928	1178	718	836	771	768	526
5B	1121	920	843	551	1226	956	1228	827	833	754	820	653
6A	2016	1589	1255	972	1782	1273	1936	1099	1308	905	1550	1046
6B	1978	1621	1333	1033	1887	1345	2023	1078	1299	1015	1562	1084
7A	2912	2550	1897	1469	2528	1748	2568	1503	1936	1264	2436	1652
7B	3087	2609	1885	1365	2408	1771	2672	1520	1937	1381	2461	1723
8A	3284	2809	2057	1896	2794	2105	2992	1745	2404	1566	2637	2006
8B	3300	2857	2051	2008	3069	2086	2939	1940	2244	1720	2471	1867
9A	3330	2881	2061	1855	2970	2368	2940	2228	2565	2160	2409	1965
9B	2182	2005	1979	1392	1799	1452	1735	1093	1434	1303	1269	1050
10A	2093	1649	1693	1123	1627	1210	1420	675	1178	1173	1476	786
10B	2395	1938	1848	1237	1846	1188	1496	663	1166	1247	1686	934
11A	2210	1696	1789	1360	2211	1443	1653	795	1766	1153	2208	1217
11B	2394	1780	1800	1416	2207	1251	1682	668	1758	1152	1859	1026
12A	2881	2277	1804	1577	2611	1638	2347	1458	1928	1360	2497	1585
12B	2882	2220	1812	1511	2620	1726	2218	1259	1824	1401	2359	1574
13A	2785	2328	1576	1471	2417	1631	2328	1812	1946	1395	2303	1673
13B	2882	2506	1647	1529	2614	1827	2535	2050	1923	1440	2301	1766
14A	2740	2345	1813	1450	2716	1778	2336	1728	1995	1426	2294	1747
14B	2745	2390	1768	1398	2754	1701	2398	1490	1897	1452	2187	1576
15A	2459	2291	1655	1427	2856	1635	2502	1905	1961	1963	1724	1594
15B	2421	2411	1690	1435	2692	1694	2550	2093	2095	1941	1901	1829
16A	3333	2113	1111	890	1481	1019	1207	836	874	759	564	676
16B	3370	2125	1127	907	1438	982	1208	841	791	778	915	613
[3] 17A	2378	1097	1739	678	2466	952	2187	824	1685	639	2027	691
[3] 17B	2316	1098	1643	658	2413	1059	2315	1129	1673	789	2094	777
[3] 18A	1078	1916	775	1384	1168	1431	1175	1763	818	1177	832	1569
[3] 18B	1169	2065	846	1448	1239	1418	1335	1792	862	1274	871	1598
19	2440	2083	1698	1421	2422	1447	2137	1413	1794	1212	2293	1392
20	929	889	837	433	.. [5]	826	943	665	696	758	845	501
21	1625	1128	1072	787	1687	1260	1666	979	1312	853	1391	842
22	1642	1195	1123	791	1615	942	1723	1067	1257	1084	1289	893

[1] Average of 9 years, 1865–73. See Note ([5]) to Appendix-Table I., p. 2. [2] Average of and 17B, are those of 10, 10 and 20 years, mineral manure succeeding ammonia-salts (Plots 17A succeeding the mineral manure (Plots 17A and 17B, or 18A and 18B). [5] Produce unknown, p. 2. [7] Average of 9 years 1864–7 and 1869–73. [8] Average of 19 years 1864–7 and 1869–83.

in lbs., per Acre, per Annum.

Harvests.								Average.			Plots.
1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	Of 10 Years, 1864–73.	Of 10 Years, 1874–83.	Of 20 Years, 1864–83.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
733	728	959	318	990	909	846	980	1060	814	937	0
440	434	654	182	655	728	605	712	804	561	683	1
1545	1481	1890	1064	2373	1907	2004	2244	2219	1883	2051	2
500	543	776	330	689	863	679	872	809	651	730	3
546	584	776	317	760	758	698	837	866	652	759	4
610	668	899	385	1128	806	793	994	888	758	823	5A
679	708	901	382	1038	805	760	1023	926	777	851	5B
962	904	1424	619	1718	1333	1466	1756	1413	1278	1346	6A
1081	847	1468	762	1610	1383	1468	1806	1461	1307	1384	6B
1444	1259	1998	969	2149	1738	2304	2357	2037	1831	1934	7A
1719	1167	2132	1133	2149	1690	2198	2399	2064	1877	1970	7B
2054	1665	2452	1318	2374	2086	2303	2871	2365	2177	2271	8A
1895	1354	2485	1384	2031	1837	2343	2695	2421	2036	2229	8B
2255	2383	2333	1462	2130	2271	2012	2905	2536	2212	2374	9A
766	1654	1408	345	654	1424	1520	1337	1637	1143	1390	9B
719	1031	1708	272	645	1168	1557	1196	1384	1056	1220	10A
848	1105	1853	370	779	1259	1672	1280	1502	1179	1340	10B
963	1182	1894	788	1673	1378	2015	1842	1607	1516	1562	11A
832	1046	1903	676	1520	1352	1951	1625	1611	1379	1495	11B
1260	1249	1906	913	1921	1525	2221	2110	1988	1719	1853	12A
1206	994	1966	952	1739	1352	2222	1977	1947	1634	1791	12B
1575	1165	1888	964	2070	1737	2105	2297	1969	1777	1873	13A
1669	1108	1917	1188	2029	1694	2048	2196	2095	1792	1943	13B
1454	1170	2085	1105	2007	1737	2235	2263	2032	1810	1921	14A
1338	1063	1994	1089	1811	1580	2134	2162	1999	1693	1846	14B
1602	1978	1334	406	2325	1535	1871	2202	2065	1657	1861	15A
1709	2036	1495	333	2242	1500	1827	2164	2102	1704	1903	15B
658	610	862	359	882	809	698	1008	1143 } [1]	713	917 } [2]	16A
669	567	837	321	885	799	655	1045	1133 }	731	921 }	16B
1709	662	1914	189	2017	826	1971	1033	920 } [4]	762 } [4]	841 } [4]	17A } [3]
1611	591	1834	255	2083	758	2004	999	1018 }	785 }	902 }	17B }
609	696	955	1284	903	1904	921	2411	1813 } [4]	1750 } [4]	1781 } [4]	18A }
639	816	976	1330	935	1892	1052	2470	1835 }	1773 }	1804 }	18B }
1147	1156	1723	573	2057	1538	1949	1986	1807	1581	1694	19
442	694	863	296	{ 1314	1410	1203	2058	..	..	1496 [6]	20–1
				{ 771	921	993	1099	775 [7]	742	758 [8]	20–2
681	710	1208	541	992	709	979	1054	1237	910	1074	21
817	1197	1163	761	1581	638	725	816	1244	988	1116	22

19 years, 1865–83. [3] See Note (6) to Appendix-Table I., p. 2. [4] The averages given for Plots 17A and 17B, or 18A and 18B); and those given for Plots 18A and 18B, of 10, 10, and 20 years, ammonia-salts owing to a mistake at harvest. [6] Average of 4 years, 1880–83. See Note (8) to Appendix-Table I.,

Appendix-Table XXV.—Total Straw (and

Plots.	Harvests.											
	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0	1575	1135	1729	1320	1855	1493	1239	1566	1873	1183	1328	1150
1	1296	1064	1301	944	1594	1180	1087	1451	1270	966	972	868
2	3893	3100	4058	3136	4190	3937	2733	4506	3761	2463	4439	3719
3	1350	1033	1269	973	973	1350	1046	1100	1152	902	990	1008
4	1337	1162	1419	999	1345	1405	1107	1277	1216	998	999	910
5A	1293	1132	1454	1099	1250	1514	1302	1340	1301	1054	845	1051
5B	1458	1220	1476	966	1442	1687	1419	1529	1361	1032	914	1198
6A	3630	1978	2207	1684	2437	2250	2269	2290	2770	1513	2212	1899
6B	3127	2063	2289	1762	2700	2280	2438	2304	2363	1527	2230	2117
7A	4897	3598	3844	2796	4017	3114	3148	3093	3611	1852	4508	3334
7B	5043	3740	3923	2727	3680	3309	3284	3076	4043	2190	4782	3509
8A	5585	4517	5318	4103	4683	3898	3635	3716	5430	2477	6182	4400
8B	5590	4682	5306	4288	4933	3937	3699	4150	4712	2850	5944	4245
9A	5985	4682	5316	4918	5180	4930	3911	4909	6527	3932	5012	4747
9B	3287	3137	4682	3246	2742	3475	2080	2425	3210	2358	2166	2363
10A	2832	2385	2792	2023	2163	2265	1627	1252	2442	1635	1977	1574
10B	3247	2677	3047	2138	2364	2186	1748	1339	2440	1642	2387	1782
11A	3440	2397	3130	2218	2790	2568	1917	1448	3387	1583	3166	2392
11B	3878	2662	3252	2402	2850	2345	1895	1279	3450	1578	3077	2217
12A	4315	3067	3473	2628	3421	2637	2577	2700	3933	1943	4011	2972
12B	4356	3148	3538	2685	3653	3008	2503	2440	3388	2037	3774	3104
13A	4480	3243	3350	2662	4010	2826	2815	3433	3988	2036	3952	3299
13B	4620	3518	3623	2822	4040	3267	2993	4125	3808	2107	4002	3231
14A	4003	3127	3563	2598	3685	3076	2584	3063	3850	2120	3570	3060
14B	4107	3195	3367	2537	3668	2999	2588	2937	3725	2172	3618	3183
15A	4003	3142	3053	2670	4656	2954	3072	3597	4011	2992	2609	2916
15B	4010	3375	3297	2730	4223	3008	3119	3808	4134	3165	2943	3491
16A	6003	2837	1955	1583	2125	1678	1365	1510	1642	1130	913	1222
16B	5990	2938	1968	1643	1962	1614	1333	1573	1466	1174	1392	1147
[3] 17A	3920	1488	3365	1193	3767	1570	2628	1608	3249	1092	3501	1247
17B	3667	1452	3582	1257	3527	1829	2715	2032	3358	1108	3473	1450
18A	1460	2785	1502	2558	1537	2433	1259	3254	1579	1805	1047	2916
18B	1600	2877	1533	2675	1672	2460	1488	3428	1761	2007	1012	3096
19	3363	2987	3347	2620	3161	2566	2242	2688	3303	1858	3136	2494
20	1332	1307	1627	948	.. [5]	1253	1175	1350	1247	1098	1312	1028
21	2323	1458	2104	1388	2267	2115	1949	1873	2216	1258	1666	1376
22	2180	1527	2127	1377	2300	1483	1996	1871	2030	1663	1547	1491

[1] Average of 9 years, 1865–73. See Note (5) to Appendix-Table I., p. 2. [2] Average o and 17B, are those of 10, 10 and 20 years, mineral manure succeeding ammonia-salts (Plots 17A succeeding the mineral manure (Plots 17A and 17B, or 18A and 18B). [6] Produce unknown p. 2. [7] Average of 9 years 1864–7 and 1869–73. [8] Average of 19 years 1864–7 and 1869–83.

[C]HAFF), in lbs., per ACRE, per ANNUM.

HARVESTS.								AVERAGE.			PLOTS.
1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	Of 10 Years, 1864–73.	Of 10 Years, 1874–83.	Of 20 Years, 1864–83.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
830	908	1420	691	1315	973	1284	997	1497	1090	1293	0
571	521	1064	428	1151	794	1109	783	1215	826	1020	1
2140	2266	4042	2239	3902	2367	3993	2930	3578	3203	3391	2
642	748	1081	763	1149	1146	1095	1006	1115	963	1039	3
706	807	992	748	1263	833	1017	978	1227	925	1076	4
792	872	1324	841	1747	909	1317	1101	1274	1080	1177	5A
777	892	1320	868	1722	897	1244	1175	1359	1101	1230	5B
1201	1172	2813	1400	3172	1595	2897	2655	2303	2101	2202	6A
1393	1179	3074	1784	2649	1663	2940	2554	2285	2158	2222	6B
2015	1983	4804	2890	4051	2269	5819	3657	3397	3533	3465	7A
2408	1687	5100	3133	3960	2137	5641	3607	3501	3596	3549	7B
3083	2477	6227	4069	5135	3169	7413	4654	4336	4681	4508	8A
2788	2010	6119	4283	3817	2643	6806	3928	4415	4258	4336	8B
3584	3852	5624	4347	4394	3640	6274	5127	5029	4660	4845	9A
1217	2540	2897	1070	1420	1817	3617	1684	3064	2079	2572	9B
922	1322	2762	889	1242	1297	2796	1419	2142	1620	1881	10A
1270	1492	2981	1006	1631	1399	3012	1524	2283	1848	2066	10B
1313	1453	4258	2086	2868	1642	3921	2466	2488	2556	2522	11A
1228	1353	4326	1955	2835	1552	3805	2158	2559	2451	2505	11B
1711	1640	4479	2555	3589	1884	4938	2854	3069	3063	3066	12A
1661	1331	4824	2384	2939	1885	4636	2668	3076	2921	2998	12B
2431	1581	4708	2776	3859	2319	4918	3504	3284	3335	3310	13A
2435	1556	4664	3327	3649	2220	4865	3225	3492	3317	3405	13B
2027	1633	5014	3072	3638	2276	4949	3128	3167	3236	3202	14A
1863	1503	4794	2734	3009	2103	4570	2941	3130	3032	3081	14B
2320	2817	2931	1019	4234	1917	4216	3227	3415	2821	3118	15A
2535	2759	3211	792	3816	2025	3981	3279	3487	2883	3185	15B
841	736	1351	808	1736	911	1293	1063	1758 } [1]	1087	1405 } [2]	16A
908	767	1312	819	1263	953	1204	1146	1741 }	1091	1399 }	16B
2605	823	4528	589	3383	926	4127	1153	1429 } [4]	1103 } [4]	1266 } [4]	17A } [3]
2474	728	4735	659	3271	878	4186	1168	1573 }	1132 }	1353 }	17B }
898	1038	1514	3283	1340	2533	1497	3932	2976 } [4]	3185 } [4]	3081 } [4]	18A }
893	1090	1596	3406	1351	2577	1587	3766	3030 }	3208 }	3119 }	18B }
1566	1452	3148	1335	3254	1815	3458	2759	2813	2442	2628	19
665	994	1212	745	{2120	1770	2045	2887	..	..	2206 [6]	20–1
				{1096	1006	1346	1110	1260 [7]	1052	1150 [8]	20–2
935	1049	1821	1138	1626	715	1618	1302	1895	1325	1610	21
1214	1725	1880	1798	2469	636	1285	887	1855	1493	1674	22

[2] years, 1865–83. [3] See Note (6) to Appendix-Table I., p. 2. [4] The averages given for Plots 17 …d 17B, or 18A and 18B), and those given for Plots 18A and 18B of 10, 10 and 20 years ammonia-sal… …ving to a mistake at harvest. [6] Average of 4 years 1880–83. See Note (8) to Appendix-Table I…

APPENDIX-TABLE XXVI.—TOTAL PRODUCE (GRAIN

Plots.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
	HARVESTS.											
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0	2816	2128	2762	1984	3259	2448	2654	2455	2933	2133	2342	1813
1	2258	1866	2010	1431	2853	1924	2143	2136	1971	1602	1662	1379
2	6488	5484	6128	4891	6794	6193	5092	7004	5807	4085	6870	5609
3	2428	1861	2046	1505	2027	2198	2002	1715	1857	1603	1684	1575
4	2422	2112	2271	1582	2448	2301	2130	1985	1933	1747	1733	1418
5A	2345	2042	2286	1708	2294	2442	2480	2058	2137	1825	1613	1577
5B	2579	2140	2319	1517	2668	2643	2647	2356	2194	1786	1734	1851
6A	5646	3567	3462	2656	4219	3523	4205	3389	4078	2418	3762	2945
6B	5105	3684	3622	2795	4587	3625	4461	3382	3662	2542	3792	3201
7A	7809	6148	5741	4265	6545	4862	5716	4596	5547	3116	6944	4986
7B	8130	6349	5808	4092	6088	5080	5956	4596	5980	3571	7243	5232
8A	8869	7326	7375	5999	7477	6003	6627	5461	7834	4043	8819	6406
8B	8890	7539	7357	6296	8002	6023	6638	6090	6956	4570	8415	6112
9A	9315	7563	7377	6773	8150	7298	6851	7137	9092	6092	7421	6712
9B	5469	5142	6661	4638	4541	4927	3815	3518	4644	3661	3435	3413
10A	4925	4034	4485	3146	3790	3475	3047	1927	3620	2808	3453	2360
10B	5642	4615	4895	3375	4210	3374	3244	2002	3606	2889	4073	2716
11A	5650	4093	4919	3578	5001	4011	3570	2243	5153	2736	5374	3609
11B	6272	4442	5052	3818	5057	3596	3577	1947	5208	2730	4936	3243
12A	7196	5344	5277	4205	6032	4275	4924	4158	5861	3303	6508	4557
12B	7238	5368	5350	4196	6273	4734	4721	3699	5212	3438	6133	4678
13A	7265	5571	4926	4133	6427	4457	5143	5245	5934	3431	6255	4972
13B	7502	6024	5270	4351	6654	5094	5528	6175	5731	3547	6303	4997
14A	6743	5472	5376	4048	6401	4854	4920	4791	5845	3546	5864	4807
14B	6852	5585	5135	3935	6422	4700	4986	4427	5622	3624	5805	4759
15A	6462	5433	4708	4097	7512	4589	5574	5502	5972	4955	4333	4510
15B	6431	5786	4987	4165	6915	4702	5669	5901	6229	5106	4844	5320
16A	9336	4950	3066	2473	3606	2697	2572	2346	2516	1889	1477	1898
16B	9360	5063	3095	2550	3400	2596	2541	2414	2257	1952	2307	1760
[3] 17A	6298	2585	5104	1871	6233	2522	4815	2432	4934	1731	5528	1938
17B	5983	2550	5225	1915	5940	2888	5030	3161	5031	1897	5567	2227
18A	2538	4701	2277	3942	2705	3864	2434	5017	2397	2982	1879	4485
18B	2769	4942	2379	4123	2911	3878	2823	5220	2623	3281	1883	4694
19	5803	5070	5045	4041	5583	4013	4379	4101	5097	3070	5429	3886
20	2261	2196	2464	1381	.. [5]	2079	2118	2015	1943	1856	2157	1529
21	3948	2586	3176	2175	3954	3375	3615	2852	3528	2111	3057	2218
22	3822	2722	3250	2168	3915	2425	3719	2938	3287	2747	2836	2384

[1] Average of 9 years, 1865–73. See Note ([5]) to Appendix-Table I., p. 2. [2] Average of
and 17B, are those of 10, 10 and 20 years mineral manure succeeding ammonia-salts (Plots 17A
succeeding the mineral manures (Plots 17A and 17B or 18A and 18B). [5] Produce unknown,
p. 2). [7] Average of 9 years 1864–7 and 1869–73. [8] Average of 19 years 1864–7 and 1869–83,

STRAW), in lbs., per ACRE, per ANNUM.

HARVESTS.							AVERAGE.			PLOTS.
1877.	**1878.**	**1879.**	**1880.**	**1881.**	**1882.**	**1883.**	Of 10 Years, **1864–73.**	Of 10 Years, **1874–83.**	Of 20 Years, **1864–83.**	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1636	2379	1009	2305	1882	2130	1977	2557	1904	2230	0
955	1718	610	1806	1522	1714	1495	2019	1387	1703	1
3747	5932	3303	6275	4274	5997	5174	5797	5086	5442	2
1291	1857	1093	1838	2009	1774	1878	1924	1614	1769	3
1391	1768	1065	2023	1591	1715	1815	2093	1577	1835	4
1540	2223	1226	2875	1715	2110	2095	2162	1838	2000	5A
1600	2221	1250	2760	1702	2004	2198	2285	1878	2081	5B
2076	4237	2019	4890	2928	4363	4411	3716	3379	3548	6A
2026	4542	2546	4259	3046	4408	4360	3746	3465	3606	6B
3242	6802	3859	6200	4007	8123	6014	5434	5364	5399	7A
2854	7232	4266	6109	3827	7839	6006	5565	5473	5519	7B
4142	8679	5387	7509	5255	9716	7525	6701	6858	6779	8A
3364	8604	5667	5848	4480	9149	6623	6836	6294	6565	8B
6235	7957	5809	6524	5911	8286	8032	7565	6872	7219	9A
4194	4305	1415	2074	3241	5137	3021	4701	3222	3962	9B
2353	4470	1161	1887	2465	4353	2615	3526	2676	3101	10A
2597	4834	1376	2410	2658	4684	2804	3785	3027	3406	10B
2635	6152	2874	4541	3020	5936	4308	4095	4072	4084	11A
2399	6229	2631	4355	2904	5756	3783	4170	3830	4000	11B
2889	6385	3468	5510	3409	7159	4964	5057	4782	4919	12A
2325	6790	3336	4678	3237	6858	4645	5023	4555	4789	12B
2746	6596	3740	5929	4056	7023	5801	5253	5112	5183	13A
2664	6581	4515	5678	3914	6913	5421	5587	5109	5348	13B
2803	7099	4177	5645	4013	7184	5391	5199	5046	5123	14A
2566	6788	3823	4820	3683	6704	5103	5129	4725	4927	14B
4795	4265	1425	6559	3452	6087	5429	5480	4478	4979	15A
4795	4706	1125	6058	3525	5808	5443	5589	4587	5088	15B
1346	2213	1167	2618	1720	1991	2071	2902 } [1]	1800	2322 } [2]	16A
1334	2149	1140	2148	1752	1859	2191	2874 }	1822	2320 }	16B
1485	6442	778	5400	1752	6098	2186	2349 } [4]	1865 } [4]	2107 } [4]	17A } [3]
1319	6569	914	5354	1636	6190	2167	2591 }	1917 }	2255 }	17B }
1734	2469	4567	2243	4437	2418	6343	4789 } [4]	4935 } [4]	4862 } [4]	18A }
1906	2572	4736	2286	4469	2639	6236	4865 }	4981 }	4923 }	18B }
2608	4871	1908	5311	3353	5407	4745	4620	4023	4322	19
1688	2075	1041	{ 3434	3180	3248	4945	..	..	3702 [6]	20–1
			{ 1867	1927	2339	2209	2035 [7]	1794	1908 [8]	20–2
1759	3029	1679	2618	1424	2597	2356	3132	2235	2684	21
2922	3043	2559	4050	1274	2010	1703	3099	2481	2790	22

rs, 1865–83. [3] See Note ([6]) to Appendix-Table I., p. 2. [4] The averages given for Plots 17A
B, or 18A and 18B); and those given for Plots 18A and 18 B of 10, 10 and 20 years ammonia-salts
to a mistake at harvest. [6] Average of 4 years, 1880–83. See Note ([8]) to Appendix-Table I.,

APPENDIX-TABLE XXVII.—AVERAGE PRODUCE per ACRE, per ANNUM,

Plots.	Dressed Grain. Quantity. 16 Years, 1852–1867.	16 Years, 1868–1883.	32 Years, 1852–1883.	Weight per Bushel. 16 Years, 1852–1867.	16 Years, 1868–1883.	32 Years, 1852–1883.
	bush. pecks.	bush. pecks.	bush. pecks.	lbs.	lbs.	lbs.
0	17 2¼	14 3¼	16 0¾	58·1	58·6	58·4
1	15 0¾	10 3	12 3¾	57·8	58·3	58·1
2	35 0½	31 3¾	33 2	59·9	60·1	60·0
3	14 3¼	11 1½	13 0¼	57·4	58·3	57·8
4	16 0½	11 2¾	13 3½	58·0	58·2	58·1
5A	17 0¼	13 0¼	15 0¼	58·7	58·7	58·7
5B	17 1¼	13 2	15 1¾	58·5	58·8	58·7
6A	26 2¾	20 3½	23 3	59·2	59·8	59·5
6B	27 1½	21 1¾	24 1¾	59·3	59·6	59·5
7A	35 3	29 1¼	32 2	59·2	59·8	59·5
7B	36 0¼	29 2¾	32 3½	59·2	59·7	59·5
8A	38 0½	34 2¼	36 1¼	58·7	59·8	59·3
8B	38 1½	33 2½	36 0	58·7	59·6	59·2
9A	35 2¾	36 3¼	36 1	58·1	59·3	58·7
9B	26 2½	20 1	23 1¾	56·5	56·5	56·5
10A	23 1¼	17 2¾	20 2	56·9	57·1	57·0
10B	27 1½	19 0½	23 1	57·9	57·3	57·6
11A	28 3½	23 3	26 1¼	57·1	58·4	57·8
11B	29 3¼	22 0¼	25 3¾	57·3	57·9	57·6
12A	34 2¾	27 3¾	31 1¼	58·9	59·5	59·2
12B	34 2¼	26 3½	30 2¾	59·0	59·1	59·1
13A	33 2½	28 2½	31 0½	59·4	60·3	59·8
13B	34 1½	29 3¼	32 0¼	59·4	60·1	59·8
14A	34 0½	29 2½	31 3½	59·0	59·7	59·4
14B	34 1¾	28 0¼	31 1	59·0	59·1	59·1
15A	32 2	28 3½	30 2¾	59·3	59·9	59·6
15B	33 3¼	29 2	31 2½	59·3	59·9	59·6
16A	39 1¾ (1)	14 2 (2)	24 2½	58·0 (1)	59·2 (2)	58·7
16B	39 2 (1)	14 2½ (2)	24 3	58·0 (1)	59·1 (2)	58·7
(3) 17A	17 3¼	13 0¼	15 1¾	58·7	58·6	58·7
(3) 17B	17 2¾	14 0¾	15 3¾	58·5	58·7	58·6
(3) 18A	31 3	27 3¼	29 3¼	59·1	60·1	59·6
(3) 18B	31 3½	28 2	30 0¾	59·1	59·9	59·5
19	31 1	25 3¾	28 2½	58·4	58·6	58·5
20–1	..	..	23 1¾ (4)	..	..	59·7 (4)
20–2	14 2¾	12 0½	13 1¾ (5)	57·7	57·8	57·7 (5)
21	21 0¾	16 3¼	19 0	58·4	58·8	58·6
22	21 0	17 2¾	19 1¼	58·3	58·6	58·4

(1) Average of 13 years, 1852–'64. (Mixed minerals and ammonia-salts.)
(2) Average of 19 years, 1865–'83. (Unmanured.)
(3) On Plots 17A and 17B, and 18A and 18B, the manures have alternated each
mineral manure on Plots 18A and 18B, in one year; mineral manure on Plots
(4) Average of 4 years, 1880–'83. See Note (8) to Appendix-Table I., p. 2.
(5) Averages of 16, 15, and 31 years only; as, in 1868, owing to a mistake

16 Years, 1852–67, 16 Years, 1868–83, and 32 Years, 1852–83.

Straw (and Chaff).			Total Produce (Grain and Straw).			Plots.
16 Years, 1852–1867.	16 Years, 1868–1883.	32 Years, 1852–1883.	16 Years, 1852–1867.	16 Years, 1868–1883.	32 Years, 1852–1883.	
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1744	1256	1500	2847	2182	2515	0
1613	988	1301	2567	1656	2112	1
3788	3352	3570	6013	5365	5689	2
1535	1009	1272	2459	1721	2090	3
1606	1038	1322	2627	1770	2198	4
1704	1160	1432	2776	1976	2376	5A
1774	1217	1496	2865	2067	2466	5B
2811	2159	2485	4486	3477	3981	6A
2878	2200	2539	4598	3557	4077	6B
4087	3385	3736	6339	5251	5795	7A
4141	3471	3806	6413	5375	5894	7B
4750	4415	4583	7161	6626	6894	8A
4785	4179	4482	7213	6327	6770	8B
4626	4749	4688	6880	7084	6982	9A
3287	2318	2802	4975	3583	4279	9B
2579	1724	2151	4066	2839	3452	10A
2990	1888	2439	4724	3100	3912	10B
3085	2454	2769	4901	3965	4433	11A
3226	2369	2797	5101	3776	4438	11B
3792	2990	3391	5971	4773	5372	12A
3829	2890	3359	6011	4602	5306	12B
3817	3278	3548	5951	5110	5530	13A
3936	3345	3640	6123	5239	5681	13B
3818	3171	3495	5983	5051	5517	14A
3839	3026	3432	6012	4815	5413	14B
3651	3093	3372	5706	4930	5318	15A
3859	3143	3501	5996	5024	5510	15B
5218 (1)	1405 (2)	2954	7708 (1)	2322 (2)	4510	16A
5215 (1)	1399 (2)	2949	7718 (1)	2320 (2)	4513	16B
1854	1230	1542	2977	2055	2516	17A (3)
1841	1326	1583	2953	2217	2585	17B (3)
3596	3061	3328	5600	4824	5212	18A (3)
3627	3098	3362	5635	4887	5260	18B (3)
3411	2515	2963	5400	4155	4778	19
..	..	2206 (4)	..	..	3702 (4)	20–1
1612	1109	1369 (5)	2546	1863	2216 (5)	20–2
2212	1558	1885	3538	2612	3075	21
2182	1642	1912	3500	2740	3120	22

year since 1852; that is, ammonia-salts on Plots 17A and 17B, and the mixed 17A and 17B, and ammonia-salts on Plots 18A and 18B, in the next year, and so on.

in carting, the produce could not be ascertained.

XVI.—*On the Chemistry of Ensilage.* By Dr. AUGUSTUS VOELCKER, F.R.S.

MR. JENKINS'S admirable, exhaustive, and instructive "Report on the Practice of Ensilage at Home and Abroad," in the last 'Journal' of this Society (vol. xx. s.s. Part I.), the numerous contributions which have recently appeared in our Agricultural newspapers on the same subject, and the several special treatises on silos, and the preservation of green fodder crops, which have been issued during the last six or twelve months, relieve me of the task of describing the construction of different silos, the kinds of crop suitable for ensilage, the various plans of preparing the green food, of filling the silos, and the subsequent application of pressure. Further, I do not intend to enter into the questions of the cost of the construction of silos, and the comparative expense of making grass and other green produce into hay with that of preserving it in silos. Nor will it be expedient for me to refer to the experience of feeders of stock respecting the value of silage for fattening purposes, or the production of milk, or to touch upon other purely practical questions raised and criticised more or less fully in Mr. Jenkins's Report, and by the current Agricultural press.

The object of the following pages is simply to supplement Mr. Jenkins's Report by a brief account of the chemical composition of a number of illustrative specimens which have recently been submitted to analysis in the Society's Laboratory, and to some of which reference has been made in Mr. Jenkins's Report. As far as I am able, in the absence of further well-authenticated and definite information, I propose, in fact, to offer some observations on the "Chemistry of Ensilage."

I feel compelled, however, to say at once that a careful and critical study of the literature of the subject, and an attentive perusal of most of the original publications on ensilage in England, America, and the Continent, have shown me how scanty and imperfect is our knowledge of the complicated processes of fermentation and of similar chemical and physical changes to which succulent green food is liable under various conditions of temperature, the total or partial exclusion of atmospheric air, or its free admission.

Comparatively few experiments, conceived in a rational and philosophic spirit, and carried out with all the precision which is justly expected from an experienced scientific investigator, have as yet been made, in which any well-ascertained facts have been brought to light, or which can be used as the basis of a sound theory of the chemistry of ensilage. In fact, we do not

possess a sufficient number of data for enabling a farmer to produce at will either what is called "sweet" or "sour" silage of good keeping quality. Indeed, in a large measure, the operation of ensilage is conducted at present in a haphazard way, owing to a deficient knowledge of the principles which regulate the changes which green food undergoes in silos.

Some experiments with ensilage, which I am now conducting personally, convince me fully of the necessity of attaching the highest importance to the regulation of the temperature of the green provender in the silos; and in due time I hope to give an account of those experiments, which are now in active progress.

Mr. George Fry has repeatedly directed attention to the importance of allowing green food, when first placed in a silo, to attain a temperature not lower than 125°, and if possible as high as 150° F., before applying considerable pressure by means of weights or a layer of sand. By this rise of temperature it passes through a process which he terms "sweet" or "hay" fermentation. Mr. George Fry is, to my knowledge, the first man who has made accurate observations pointing out the influence of temperature on the production of the aromatic or fruity smell which grass, clover, and similar green produce, acquire when put into a silo without any pressure beyond that exercised by the mass of ensilaged green food upon the lower layers. In my judgment, his are the only systematic and accurate experiments which have been undertaken anywhere with the special object of studying the process of the heating of green food in the silo, and great credit is due to him for his persistent advocacy of the plan which he pursues, and which he considers essential for converting grass, even of an insipid and inferior quality, and other green fodder crops, into a very palatable and nutritious food which is much relished by stock of every description.

As far as my present experience goes, there is a great deal in what Mr. Fry says with respect to the regulation and maintenance of a proper temperature in the silo. From his observations, it would appear that the too rapid exclusion of air by weighting the silage as soon as it is put into the silo prevents the green food from attaining a temperature of 125° F., below which, in his view, sweet or hay-fermentation does not take place, but instead either lactic or acetic fermentation. It certainly is a fact that silage showing not more than a trace of acidity, and as sweet and almost as aromatic as well-made hay, has been made by Mr. George Fry, and could be made by anybody who would strictly adopt the directions which he gives for making sweet silage. Such silage, I find, keeps only a short

time on exposure to the air, and soon turns mouldy, whilst well-made sour silage may be kept sound for six or nine months, and even longer, when freely exposed to air, without turning mouldy. Some of the best samples of sour silage which I analysed last January, and which I kept in the Society's Laboratory, without taking any particular care to exclude air, remain at the time of writing (August) still quite sound and perfectly free from mould; in fact, even after the great heat of this summer, they are as good as they were when they first reached me.

At the same time I must mention that sour silage does not always keep well, as I shall presently show. I am now engaged in investigating the circumstances under which sour silage keeps well for a reasonably long time, and those under which it rapidly turns mouldy and gets spoilt on exposure to the air. As far as I am able to judge, and, I must confess, from an insufficient number of not altogether conclusive facts, I think it likely that the whole difference in the keeping qualities of sour silage depends upon whether the silage has passed through the lactic acid fermentation (which takes place on the more or less complete exclusion of air), or through the alcoholic and subsequent acetic acid fermentations (which proceeds with facility only if air has free access). In most cases I find that acetic acid fermentation precedes mouldiness; and although very mouldy silaged grass or clover is rarely very acid, and sometimes has even an alkaline reaction, it does not follow from the absence of an acid reaction that the mouldy silage has not undergone acetic acid fermentation; for it is well known that vinegar loses by degrees its acidity in measure as it becomes more and more mouldy. The fungus which causes the mouldiness in flat vinegar appears to consume the acetic or vinegar acid, and to live upon its constituent elements. That there are great differences in the quality of the silage made from different kinds of green food, or even from the same food made on different farms, or on the same farm in different seasons, admits of no doubt. These differences are attributable in a great measure to the quality of the original green food, as regulated by its composition, and more especially by its state of maturity. Generally speaking, well-ripened nutritious grass or clover, which is sweet to the taste and comparatively rich in sugar, when under conditions favourable to the production of either sweet or sour silage, makes a better, more nutritious, and more wholesome food than immature or over-ripe green food, which originally is either so immature as to contain hardly any sugar, or else so over-ripe as to have become insipid and woody.

Immature green food, as a rule, does not keep well when put into silos; and over-ripe stringy green food abounding in cellular fibre often keeps extremely well when submitted to the process of ensilage; but it never makes really good nutritious silage, for the simple reason that the constituents upon which the nutritive qualities of the food mainly depend, and which are most liable to suffer changes by fermentation, are present only in small proportion, whilst the less perishable matters, such as cellular and woody fibre, form the bulk of the over-ripe green food. It may be said, with great truth, that the quality of the stuff which comes out of a silo varies much with that of the green food which is put into it. Good well-matured green food will make first-class silage if the process of ensilage is properly carried out, whilst innutritious immature or over-ripe woody grass or clover, or similar green food, by no kind of fermentation nor modification of the process of ensilage can be possibly converted into a really good food. Ensilage may render such food more palatable and improve its physical condition, in consequence of which it may become more digestible, but it can never change it into really good and nutritious provender.

Besides this, the quality of silage is no doubt influenced by the conditions under which it is made, because the variable conditions must result in corresponding modifications of the process of fermentation. When the influence of these differences in the original composition of the green food, and of the varying conditions of filling the silo and applying pressure to the green food, has been more thoroughly understood than it is at present, I have no doubt that silage of a uniform and desired quality will be produced with certainty. As yet we have a great deal to learn before this desirable object can be accomplished, for the changes which green food undergoes by fermentation are admitted to involve much uncertainty, which can only be dispelled by careful observations and well-conducted experiments. Instead of pursuing further the inquiry into the chemical changes which take place in green food when preserved in silos, I proceed to direct attention to the composition and quality of a number of representative samples which I have recently analysed.

1 and 2. *Sweet Silage.*—Two samples of "sweet silage" were sent to me for analysis on the 18th of January, 1884, by Mr. George Fry, of Chobham. One was made from clover and rye-grass mixed, the other from ordinary meadow-grass. Both were sweet to the taste, and had an agreeable fruity smell, similar to that of well-made hay.

On analysis these two samples gave the following results:—

	Silage made from	
	Clover and Rye-grass, Mixed.	Meadow Grass.
Moisture	75·80	74·40
*Albuminous compounds	2·53	2·56
Sugar and other carbo-hydrates soluble in water ..	1·43	2·99
Crude vegetable fibre	18·31	17·90
Mineral matters (ash)	1·93	2·15
	100·00	100·00
* Containing nitrogen	·40	·41
Volatile acids, calculated as acetic acid	·01	·04
Non-volatile acids, calculated as lactic acid ..	·01	·02

It will be seen that these specimens contained mere traces of acid, in fact no more than meadow-grass generally contains in its natural state. It is an extremely interesting fact that perfectly sweet silage has been made by Mr. Fry, as he states, by allowing the heat in the silo to rise above 125° F. This he accomplishes by filling his silos without close packing, and by deferring weighting the mass for two or three days, until the temperature of the silage at a depth of about 4 feet from the bottom of the silo has risen to a temperature rather higher than 125° F. He then covers the silage with close-fitting boards, upon which he places weights or sand to a depth of about 9 inches, whereby the air is excluded and a steady uniform pressure is applied. Mr. Fry's practice differs essentially from that generally adopted of applying pressure directly the silo is filled, and which results in the production of more or less sour silage; whereas, by allowing the heat of the loosely-packed silage to rise to about 125° or 140° F. before covering the top of his silo, and then applying pressure, the production of sour silage is entirely prevented, and what Mr. Fry calls "haying fermentation" takes place.

In 1883, Mr. George Fry of Chobham filled a silo with *Trifolium incarnatum*, "rough grass," and "clover and rye-grass," between the 7th and 30th of June; the temperature recorded at the time of covering being 132° F., 6 feet from the surface: the silo was then weighted with 12 inches of sand. On July 11th, and again on the 17th, the cover was taken off, and the silo was filled with meadow-grass sufficient to replenish the space caused by settling; the temperature observed at

these dates was 140° F., at a depth of 6 feet. In another silo filled with clover and rye-grass and meadow-grass between June 30th and July 11th, after which the silo was weighted with sand, the recorded temperatures were, on July 7th, 149° F., and on July 14th, 158° F. The resulting silage was free from acidity, sweet, and of an agreeable fruity odour, much resembling that of good hay, and was eaten with apparent relish by cattle, sheep, and horses.

In filling silos, most writers on ensilage give directions which are based on Liebig's chemical theory of fermentation; they recommend the thorough consolidation of the green fodder as it is put in, the rapid filling of the silo, and the covering up and weighting of it at once, in order to prevent, as far as possible, the exposure of the fodder to the oxygen of the atmosphere, which is assumed to be the exciting cause of fermentation. Pasteur's recent investigations, however, have greatly enlarged our knowledge of the conditions which favour fermentation. He has shown that oxygen itself is not directly concerned in the process, but that certain living ferments and germs, generating various kinds of bacteria of fermentation, greatly modify the character of the silage produced.

It would appear that a temperature of about 125° is sufficiently high to kill the bacteria which produce acid fermentation, and if the bacteria are killed, and the silo is covered and weighted, the enclosed mass of green fodder will remain sweet, and be practically preserved under the same conditions as fruits, vegetables, or meats are preserved when canned. If this be the case, it will be at once intelligible that by less packing of the fodder when put into the silo, and extending the time of filling until the temperature rises to a point which is fatal to the bacteria, the resulting silage will be sweet, and free from acidity; while sour silage is produced by at once consolidating, covering up and weighting the green fodder, so as to prevent the temperature rising to the point fatal to the bacteria.

3. Another sample of "sweet" silage was sent to me for analysis on the 24th of December, 1883, by Lord Middleton, Applecross, Ross-shire. It was made from oats cut green and chaffed. It had the following composition:—

Water	74·80
*Albuminous compounds	2·18
Sugar and other carbo-hydrates soluble in water	2·78
Crude vegetable fibre	18·84
Mineral matter (ash)	1·40
	100·00
* Containing nitrogen	·35
Volatile acids, calculated as acetic acid	·07
Non-volatile acids, calculated as lactic acid	·01

The taste of this sample was very sweet, and the smell quite fragrant, like that of well-made good hay. It kept well for about ten days, and then turned mouldy.

4. Lord Middleton sent me on the same day (Dec. 24th, 1883) another sample, which was made from unchopped meadow-grass, put into the silo in September 1883.

On analysis, the meadow-grass silage was found to have the following composition:—

Water	74·40
*Albuminous compounds	1·62
Soluble carbo-hydrates	2·87
Crude vegetable fibre	19·27
Mineral matter (ash)	1·84
	100·00
* Containing nitrogen	·26
Volatile acids, calculated as acetic acid	·21
Non-volatile acids, calculated as lactic acid	·22

The silage was of good quality, and kept better than the sweet chopped oats silage, which contained mere traces of acid; whilst that from unchopped meadow-grass was decidedly acid, and contained about $\frac{1}{4}$ per cent. of butyric and other soluble acids, and about the same proportion of non-volatile lactic acid.

5. Mr. E. B. Gibson, Saffron Walden, also sent me a sample of sweet silage, which, on analysis in January 1884, gave the following results:—

Water	75·60
*Albuminous compounds	2·62
Soluble carbo-hydrates	2·04
Crude fibre	17·85
Mineral matter (ash)	1·89
	100·00
* Containing nitrogen	·42
Volatile acids, calculated as acetic acid	·07
Non-volatile acids (lactic acid)	·04

It will be seen that this sample contained scarcely any volatile or non-volatile acids. It kept fairly well for about a fortnight, and then turned mouldy.

6. On the 12th of November, 1883, I received from Mr. Ed. B. Gibson a sample of clover and sainfoin silage, which I submitted to a detailed analysis, which gave the results shown on page 489 to be the composition of the mixture.

This sample contained only $57\frac{1}{2}$ per cent. of water. It was decidedly acid, and found to contain in round numbers $\frac{3}{4}$ per cent. of lactic acid and $\frac{1}{4}$ per cent. of volatile acid, and went rapidly mouldy.

Composition of a Sample of Clover and Sainfoin Silage sent by Mr. Edmund B. Gibson, Saffron Walden, November 12*th*, 1883.

Soluble in Water 70·36 per cent.	Water	57·55
	Soluble albuminoids	3·43
	Acetic and other volatile acids	·28
	Fixed (lactic acid)	·76
	Soluble non-nitrogenous extractive matters	6·11
	Soluble mineral matters	2·23
Insoluble in Water 29·64 per cent.	Insoluble albuminoids	4·44
	Crude vegetable fibre	23·32
	Insoluble mineral matters	1·88
		100·00
	Total nitrogen	1·26

7. *Green Maize-silage, made by M. Goffart, of Burtin, in the Sologne.*—On the occasion of Mr. Jenkins's visit to France last winter he brought with him a boxful of maize-silage from M. Goffart's silo, which had not previously been exposed to the air, and handed it to me for analysis. This gave the following results:—

Water	78·80
*Albuminous compounds	1·12
Soluble carbo-hydrates	4·55
Crude fibre	13·64
Mineral matters (ash)	1·89
	100·00
* Containing nitrogen	·18
Volatile acids, calculated as acetic acid	·07
Non-volatile acids, calculated as lactic acid ..	·06

M. Goffart's green maize-silage had an aromatic sweet taste, and, as the preceding analysis shows, contained but little acid. It reached me in perfectly sound condition, and although no precaution was taken to keep the air from it, kept perfectly sound and free from mouldiness up to the middle of July; and even now a sample kept in a loosely-stoppered bottle is only just beginning to show some mouldiness.

It is remarkable that the maize-silage, as treated by M. Goffart, kept well and sound for fully six months after it had been taken out of the silo, and in spite of the fact that it contained nearly 79 per cent. of water; or, in other words, that in round numbers 100 parts contained only about $\frac{1}{5}$ of dry solid food and $\frac{4}{5}$ of water.

8. *Green Maize-silage, grown in Canada in* 1882 *by the Hon. Mr. Cochrane.*—A sample of maize-silage, which was grown in Canada in the summer of 1882, was forwarded to me from that country, and reached me on the 15th of January,

1883, when I submitted it to complete analysis with the following results:—

COMPOSITION of GREEN MAIZE-SILAGE from CANADA.

	Natural State.	Dried at 212° F.
Water	85·69	..
Fatty matters and chlorophyll	·50	3·80
Acetic, butyric, and other volatile acids	1·11	(15·88)
Lactic acid	·11	1·05
Carbo-hydrates, soluble in water	·93	6·66
*Albuminous compounds "	·44	3·35
Mineral matters "	·48	3·70
Digestible fibre	4·94	37·41
†Albuminous compounds insoluble in water	·68	5·18
Mineral matters "	·42	3·20
Indigestible woody fibre	4·70	35·65
	100·00	100·00
* Containing nitrogen	·07	·53
† "	·11	·83

It will be noticed that this sample in its natural state contained over 1 per cent. of acetic, butyric, and other volatile acids, and only 0·11 per cent. of lactic acid; calculated for the dry substance, nearly 16 per cent. of volatile and 1 per cent. of non-volatile lactic acid were present.

The silage tasted strongly acid, and had an agreeable aromatic acid smell, somewhat resembling that of pickled cabbage. It was sent me in an ordinary pickle-bottle, and reached me in a perfectly sound condition. I have kept it ever since in the loosely-covered jar in which it was sent over from Canada, and up to the present date (August 8th, 1884) it shows no signs whatever of mouldiness or of decomposition, and is still as sound and well preserved as when it reached me in January 1883, and has apparently lost none of its strongly acid taste. This is a remarkable instance of well-made sour silage keeping in a sound condition for more than eighteen months, without any care having been taken to exclude the air from it. In this case it can scarcely be doubted that the large percentage of acids and aromatic compounds generated during the process of ensilage has had a material influence in the preservation of the silage.

9 and 10. *Maize and Rye-grass Silage, from Boston, Mass.*—Mr. Fowler, M.P. for Cambridgeshire, in March 1883 sent me two large barrels, one filled with rye, and the other with green

maize silage, which he had received from a correspondent, Mr. Edward Atkinson, of Boston.

On opening the barrels I found the maize-silage from Boston perfectly sound. The rye-silage also was in a good condition, with the exception of a few bits on the top of the barrel, which were slightly mouldy. On exposure to the air, the maize-silage kept much longer free from mould than the rye-silage.

Both were decidedly acid, the maize more so than the rye-silage.

The proportion of organic acids in silage varies a good deal in different samples of even the same green fodder, and the nature of the organic acids which are generated in the process of ensilage also varies greatly in different samples. In some cases of well-made silage of excellent keeping qualities, the prevailing acid is non-volatile lactic acid ; in other samples which have kept equally well, volatile and aromatic-smelling acids, such as butyric and acetic acids, were present in proportions preponderating over the amount of non-volatile lactic acid. In the present state of our knowledge of the chemical changes which green fodder undergoes in the silo, I am not prepared to assign any greater or more marked influence on the keeping qualities of silage to the volatile than to the non-volatile organic acids. The fact that the maize-silage could be taken from the pits, packed into a cask, and sent to England in good condition, and on subsequent exposure to the air kept better and longer sound and free from mould than the rye-silage, was probably due to the circumstance that the green maize was richer in sugar than the rye. In most cases the greater part of the sugar in green fodder is converted in the silo into various kinds of organic acids, some of which possess strongly marked preservative properties. In the case of well-matured green maize, the amount of sugar in the sweet stems, it can hardly be doubted, must be much more considerable than in the over-ripe rye. Much of the success in preserving green fodder in silos, I am persuaded, depends upon its proper state of maturity. Green rye, maize, clover, meadow-grass, and, in fact, all kinds of succulent vegetable produce, should be cut down neither too immature nor over-ripe, but just a little before it arrives at full maturity, and when it is sweet to the taste and rich in sugar. Fairly mature green fodder, I find, makes more nutritious silage, and keeps better when removed from the silo and exposed to the air, than silage made from immature green fodder or such food in over-ripe condition.

The following are the results which I obtained by careful and detailed analyses of average samples, drawn from the two barrels from Boston, Mass. :—

Composition of Rye and Maize Silage sent from Boston, and Analysed March 10th, 1883.

	Rye Silage.		Maize Silage.	
Water	75·19		82·40	
Fatty matter and chlorophyll	·86	Dry substances, soluble in Water, 4·08 per cent.	·59	Soluble in Water, 5·75 per cent.
Butyric and other volatile acids ..	·11		·22	
Lactic and non-volatile acids	·02		1·26	
Soluble carbo-hydrates	1·10		2·58	
*Soluble albuminous compounds ..	1·01		·50	
Soluble mineral matters	·98		·60	
†Insoluble albuminoids	·75	Dry substances insoluble in Water, 20·73 per cent.	·76	Insoluble in Water, 11·85 per cent.
Digestible cellular fibre	8·41		5·43	
Indigestible woody fibre	11·08		5·14	
Insoluble mineral matters	·49		·52	
	100·00		100·00	
* Containing nitrogen	·16		·08	
† " "	·12		·12	

The rye-silage, it will be seen, contained about 7 per cent. less water than the maize-silage, and much less acid than the latter, which appears to have been too far advanced in growth, and to have become rather woody before it was ensilaged.

The maize silage was the better food of the two. Both were good and wholesome foods. Well-made silage, in conjunction with decorticated cotton-cake, produces abundance of good and rich milk.

After having taken quantities requisite for the analyses, I sent the two barrels to our farm-manager at Woburn, who reported to me that the cattle took the silage at once, and apparently liked it much, and, as far as could be judged, did well upon it. Strange to say, fattening pigs did not seem to care for either the rye- or maize-silage, and would not touch them at first.

Mr. Edward Atkinson, of Boston, Mass., writes:—"It may interest the public to know that I measured off half an acre of good land and planted it in the autumn with winter rye, which I reaped a little too late, when the straw had hardened, about the middle of June of last year. I then planted Southern corn (maize), the growth of which was checked considerably by the drought, but which reached an average height of 10 feet, and which was cut in September. I computed the total of the two crops at 20 tons, and I think it would have been 4 or 5 tons more except for the drought. I shall carry my two cows from fall feed to summer pasture, with a considerable quantity left over.

11. *Green Vetches, chopped, grown by Mr. J. Ashworth, Longley Hall, Sheffield.*—A sample of this silage, which kept remarkably well for more than four months without any precaution being taken to prevent free access of air, was received and analysed on the 11th of December, 1883, with the following results:—

Water	78·40
*Albuminous compounds	3·12
Soluble carbo-hydrates	1·82
Crude fibre	14·27
Mineral matter (ash)	2·39
	100·00
* Containing nitrogen	·50
Volatile acids, calculated as acetic acid ..	·17
Non-volatile, lactic acid	·48

This sample, it will be seen, contained about 78½ per cent. of water, and about ½ per cent. of lactic acid, and comparatively little acetic acid.

12 and 13. *Lord Tollemache's Silage.*—Lord Tollemache sent me from Peckforton a sample of silage on the 13th of December, 1883, and a second on the 27th of the same month, which gave the following results:—

	First Sample.	Second Sample.
Water	71·60	73·40
*Albuminous compounds	3·25	1·93
Soluble carbo-hydrates	2·28	7·53
Crude fibre	18·81	15·46
Mineral matter (ash)	4·06	1·68
	100·00	100·00
* Containing nitrogen	·52	·31
Volatile acids, acetic acid	Not determined	·24
Non-volatile acids, lactic acid	·25	1·20

The first sample of Peckforton silage, containing 71·6 of water, did not keep well, as before the acid in it could be determined it got mouldy; the second, however, kept better, and contained, as will be seen, 1·2 per cent. of lactic acid and about ·25 of volatile acids. In the preparation of the first sample about 2 lbs. of salt per cwt. of the green food had been used, which accounts for the high percentage of ash. In the second sample of silage the salt appears to have been omitted; the addition of salt, it would appear, is unnecessary, if not somewhat injurious to the keeping qualities of silage.

14. *Green Oats and Dills.*—Mr. C. Cumming, of Derby, sent me a specimen of silage made with chopped green oats and dills on the 20th of March, 1884, which was composed as follows:—

Water	66·01
*Albuminous compounds	4·31
Soluble carbo-hydrates	3·50
Crude fibre	21·20
Mineral matters (ash)	4·98
	100·00
* Containing nitrogen	·69
Volatile acids, calculated as acetic acid	·39
Non-volatile acids, calculated as lactic acid ..	·61

This silage was strongly acid to the taste, was of a brown colour, and had an agreeable aromatic smell. A portion of it, kept in a loosely stoppered bottle up to the present time (August 10th), has remained perfectly free from mould, and is in as good a condition as when received on March 20, 1884.

15, 16, 17, 18. *Clover Silage.*—The following is the composition of four samples of clover-silage:—

	1.	2.	3.	4.
Water	65·20	56·80	61·40	70·80
*Albuminous compounds	3·62	6·37	6·37	4·31
Soluble carbo-hydrates	7·49	2·43	2·87	2·12
Crude fibre	20·75	30·01	26·20	20·43
Mineral matter (ash)	2·94	4·39	3·16	2·34
	100·00	100·00	100·00	100·00
* Containing nitrogen	·58	1·02	1·02	·69
Volatile acids, acetic	·63	·26	·34	·07
Non-volatile acids, lactic	1·26	·72	·87	·36

No. 1 *sample* was received on December 13th, 1883, from Mr. W. H. Wills, M.P., Coombe Lodge, Blagdon, Somerset; the silo from which it was taken having been filled on July 3rd, 4th and 5th with a second year's crop of clover after wheat, cut when ripe, and chopped to 1½ inch in length; no salt or other material was mixed with it. The silo was opened on November 4th, just four months after it had been filled and closed. This silage, containing 1¼ per cent. of lactic acid and 0·63 of butyric and other volatile acids, was very acid to the taste, and did not get mouldy on exposure to the air.

No. 2 *sample* was aftermath-clover, grown by Mr. C. Cumming, of Derby, and was put in the silo chopped, and in a ripe con-

dition. It contained about 1 per cent. of total acids, and had an agreeable aromatic smell, and was much relished by cattle. A portion of it put in a glass bottle has kept up to the present time as sound as on the 20th of March, the date of its arrival in the Laboratory.

No. 3 *sample* was received on February 16th, 1884, from Mr. W. P. Boghurst, Frating Abbey, Colchester, and had likewise a strongly acid taste, as it contained nearly 1 per cent. of non-volatile and ·34 of volatile acids, and, like the preceding sample, it remained quite sound for more than three months.

No. 4 *sample* was sent to Mr. Jenkins on February 16th, 1884, by Vicomte Arthur de Chezelles, Domaine de Boulleaume, près Chaumont-en-Vexin (Oise). It consisted of clover, which had been put in long, owing to an accident to the chopping-machine, and was compressed by about 12 inches of earth, no boards or other weights being used. It had a very aromatic agreeable smell. The box containing it was placed in the Laboratory without any covering, and did not become mouldy for over a fortnight. This silage was much more succulent than the three other clover-silages, and, although it contained only traces of acetic acid and ·36 of lactic acid, it kept well for a reasonable length of time.

19 and 20. *Grass-silage, sent by the Rev. C. H. Ford, Bishopton, Ferry Hill, Durham, received December 4th,* 1883, *and Silage received December 5th,* 1883, *from Mr. J. N. Edwards, of Westminster Lodge, St. Albans.*—On analysis of these two samples the following results were obtained :—

	Rev. C. H. Ford's Silage.	Mr. Edwards's Silage.
Water	73·70	51·10
Soluble albuminoids	2·30	2·57
Insoluble albuminoids	93	1·12
Soluble carbo-hydrates	3·75	5·86
Crude fibre	16·77	33·66
Soluble mineral matter	1·59	4·60
Insoluble mineral matter	·96	1·09
	100·00	100·00
Total nitrogen	·51	·59
Volatile acids (acetic acid)	·17	..
Non-volatile acids (lactic acid)	·76	·57

The differences in the amount of water in the two samples, it will be seen, is very great. The grass from which Mr. Edwards's silage was made was over-ripe and woody. The sample ana-

lysed was taken 4 feet from the top of the silo, and although it contained only 51 per cent. of moisture, it rapidly went mouldy. Mr. Ford's silage was made from unchopped grass, containing 73·7 of moisture, and also rapidly got mouldy on exposure to the air. Both samples were decidedly acid.

21. *Thousand-headed Kale*, chaffed, was placed in a silo by Mr. G. M. Allender on August 29th. Analysed about a month afterwards, it gave the following results:—

Water	86·97
Soluble albuminoids	·82
Insoluble albuminoids	1·22
Soluble carbo-hydrates	2·30
Crude fibre	6·64
Soluble ash	1·53
Insoluble ash	·52
	100·00

Total nitrogen	·32
Volatile acids (acetic acid)	·09
Non-volatile acids (lactic acid)	·33

A large, wide-mouthed glass bottle was filled with this silage, and kept in the Laboratory for a period of three months, after which the acid was again determined, and found to amount to—

Volatile acids (butyric and other volatile acids)	·37
Non-volatile acids (lactic acid)	·78

thus, after three months keeping, showing a large increase in the proportion of acid in the silaged kale. Although no precaution was taken to exclude the air, the silage, which had an aromatic smell and sour taste, resembling that of "Sauer-kraut," kept sound, and perfectly free from mould.

22. *Sewage-grass made into Silage by Mr. Garrett Taylor, Trowse House, Norwich.*—The silo was filled in July with sewaged Italian rye-grass, which was chopped by steam into $\frac{1}{4}$-inch lengths by Maynard's chaff-cutter; at the same time a little salt was used in packing the silo, with a view to the better preservation of the green food. Mr. Garrett Taylor sent me a sample, which reached me on January 2nd, 1884, in a perfectly sound condition, and on analysis furnished the following results:

Moisture	55·00
*Albuminous compounds	7·75
Soluble carbo-hydrates	5·18
Crude fibre	27·52
Mineral matters (ash)	4·55
	100·00

* Containing nitrogen	1·08
Volatile acids (calculated as acetic acid)	·86
Non-volatile acids (lactic acid)	·19

Sewage-grass on an average contains from 82 to 84 per cent. of moisture; it is evident, therefore, that Mr. Taylor must have allowed his Italian rye-grass to get dead ripe before pitting it. In consequence of this, the silage got unusually dry. The sample taken from the middle of the silo had a brown colour, an aromatic smell, resembling that of brown hay, and was very acid to the taste. It will be seen that it contained over 1 per cent. of total acids, most of which consisted of butyric and acetic acids, resembling in this respect the maize-silage which had been sent to me from Canada, and was distinguished for its remarkable keeping qualities. Both the Canadian maize and the sewage Italian rye-grass appear to have undergone a thorough fermentation, resulting in the production of much butyric and acetic acid, which probably accounts for the excellent keeping qualities of these two samples. It certainly is a remarkable fact that the silage made from sewaged Italian rye-grass, in a large wide-mouthed bottle, placed in the Laboratory last January, up to the present date (August 9th), and during unusually hot summer weather, has remained perfectly free from mould, and is in all respects as sound as it was in January.

23. *Silage made by Mr. W. Stobart, Pepper Arden, Northallerton.*—A large proportion of the materials in Mr. Stobart's silos was rough grass from under trees, from roadside-cuttings, and odds and ends of every description from nooks and corners in the park.

A sample received on the 21st of August, 1883, had the following composition:—

Water	76·01
Soluble albuminous compounds	·91
Insoluble albuminous compounds	1·78
Soluble carbo-hydrates	2·87
Crude fibre	15·82
Soluble mineral matters (ash)	1·63
Insoluble mineral matters (ash)	·98
	100·00
Total nitrogen	·43
Volatile acids (calculated as acetic acid)	·19
Non-volatile acids (lactic acid)	1·24

This silage, which was strongly acid, kept very well. It contained $1\frac{1}{4}$ per cent. of lactic, but only ·19 of volatile acids.

Mr. Stobart's silos are heavily weighted, and provided with taps at the bottom, from which juice is drawn off from time to time and used for the pigs, who take it greedily. A specimen of the drainage from one of Mr. Stobart's silos had a specific gravity of 1·022, and contained per imperial gallon—

	Grains.
Albuminous compounds	1,008·56
Fixed acid (lactic acid)	516·42
Volatile acids (butyric and acetic acid) ..	476·70
*Carbo-hydrates and amides	1,528·42
Mineral matters (ash)	1,768·20
Water	64,701·70
	70,000·00
* Containing non-albuminous nitrogen ..	35·84

The dry matter (dried at 212° F.) which was left on evaporation of its drainage contained in 100 parts—

*Albuminous compounds	20·90
Lactic acid	10·71
†Carbo-hydrates and amides	31·73
Mineral matter (ash)	36·66
	100·00
* Containing nitrogen	3·34
† Containing nitrogen	·51

24 and 25. *Grass-Silage, made by Mr. J. Swan, Stonefield, Lincoln.*—Two samples of silage received from Mr. Swan on November 2nd, 1883, one from the top and the other from the bottom of the silo, on analysis were found to have the following composition :—

	From Top of the Silo.	From Bottom of the Silo.
Water	77·80	82·60
*Albuminous compounds	2·06	1·50
Soluble carbo-hydrates	3·03	3·68
Crude fibre	14·72	10·35
Soluble ash	1·40	1·21
Insoluble ash	·99	·66
	100·00	100·00
* Containing nitrogen	·33	·24
Total acidity (calculated as acetic acid)	·64	·79

The sample taken fom the top was drier, and contained less acid than that from the bottom of the silo.

The top silage soon turned mouldy, but that from the bottom of the silo, although it was dripping wet, kept sound for a period of more than six months, when preserved in a large wide-mouth stoppered bottle. The drainage-liquid from one of Mr. Swan's silos had the following composition :

		Dried at 212° Fahr.
Water	94·63	..
*Albuminoids	1·50	27·93
Lactic acid	·88	16·39
Soluble carbo-hydrates, &c.	1·29	23·99
Mineral matter (ash)	1·70	31·69
	100·00	100·00
* Containing nitrogen	·24	4·47

The drainage-liquids from silage made from succulent green food, when too great a weight is placed on the top, it will be seen, is rich in albuminous and soluble non-nitrogenous food-constituents, and therefore ought not to be allowed to run to waste.

In none of the samples of silage which have been brought under my notice was I able to detect even traces of alcohol. It must, however, be borne in mind that all the samples were received by me in a comparatively advanced stage of preparation, in which most were strongly acid. The few samples which were sweet and free from acid had not, I think, undergone alcoholic fermentation; but the samples in which I found from ½ to 1 per cent. of acetic acid had, I believe, all passed through alcoholic fermentation; and had they been examined at an earlier stage of preservation, small quantities of alcohol would have been found, for the production of acetic acid is always preceded by the production of the peculiarly pungent and aromatic-smelling volatile substance known to chemists by the name of aldehyde. In fact, acetic acid is readily formed by allowing free access of air to porous materials impregnated with the vapours of aldehyde. Acetic acid may be described simply as a product of oxidation of aldehyde, which in its turn is generated from alcohol, by the abstraction of a definite proportion of its hydrogen.

When sweet vegetable juices enter into alcoholic fermentation, the sugar contained in them is converted more or less completely into alcohol and a number of by-products, according to the conditions in which the fermentable liquids are placed and the fermentation is regulated as regards temperature.

At a certain stage of the process of ensilage I have often noticed that silage smells strongly of aldehyde; but this smell soon passes off, and in its place acetic acid makes its appearance. As a rule, I find the nitrogen in silage occurs not only in the form of albuminoids, but also in variable proportions as

amides. On distillation with water, some of these amides split up, and yield ammonia. However, I find that green fodder, such as grass, clover, Italian rye-grass, &c., when simply distilled with water, yields an appreciable amount of ammonia in the watery distillate, which, I take it, arises from a portion of the amides, which exist in considerable quantities in all unripe green fodder. The presence of amides in silage is thus no proof of the reduction of albuminous compounds, upon which the nutritive value of all food depends, into amides, which, rightly or wrongly, are held to have little or no nutritive value. It is quite possible that a portion of the albuminoids in the green food in the process of ensilage may be changed into amides; but as green food contains amides in considerable proportions, especially when the fodder is rather immature, the question of the alleged reduction of albuminous nutritive compounds into innutritious amides can only be settled by a series of careful quantitative analyses of the fresh green food and of the silage produced from it.

In the preceding analyses the total percentage of nitrogen in silage was ascertained by combustion with soda-lime, and calculated as usual as albuminoids.

In six samples, however, I determined separately, by Professor Church's phenol process, the nitrogen which actually existed in the silage in the form of albuminous compounds, and the nitrogen occurring in it in the shape of amides, or similar non-albuminous compounds. The following results were obtained:—

	Albuminoid Nitrogen.	Non-Albuminoid Nitrogen.
	per cent.	per cent.
1. Mr. Stobart's silage from Pepper Arden	·26	·17
2. Mr. Edwards's silage from St. Albans	·30	·29
3. M. Goffart's maize-silage from France	·11	·07
4. Mr. George Fry's clover and rye silage	·38	·02
5. Lord Tollemache's Peckforton grass-silage	·24	·07
6. M. E. B. Gibson's Saffron Walden silage	·37	·05

The relations of albuminoid to non-albuminoid nitrogen in these six samples, expressed in percentages, are shown on page 501.

It will be seen that the relative proportions of albuminoid and non-albuminoid nitrogen in these six samples of silage varied greatly; and it is worthy of special notice that Mr. George Fry's "sweet" silage, in which I found merely traces of acid, 95 per cent. of the total nitrogen occurred in the form of albuminous compounds.

	Percentage of Albuminoid Nitrogen.	Percentage of Non-Albuminoid Nitrogen.
	per cent.	per cent.
No. 1 Silage	60·4	39·6
No. 2 "	50·8	49·2
No. 3 "	61·1	38·9
No. 4 "	95·0	5·0
No. 5 "	77·4	22·6
No. 6 "	88·1	11·9

I may further mention that some time ago Professor Kinch, of the Royal Agricultural College, Cirencester, published some analyses of silage in the 'Journal of the Chemical Society,' in which he stated separately the percentages of albuminoid and non-albuminoid nitrogen. I am also indebted to Professor Kinch for a communication stating the following additional determinations:—

Silage from Waxlow Farm, near Southall (mentioned in the 'Field,' January 19th, 1884).

GRASS SILAGE—	per cent.	
Water	76·33	
Total N. in dry matter	2·16	
Albuminoid N. "	1·17	
∴ of the N.	54·1	is albuminoid N.
and	45·9	is non-albuminoid.
CLOVER SILAGE—	per cent.	
Water	80·98	
Total N. in dry matter	2·66	
Albuminoid N. "	2·15	
∴ of the nitrogen	80·8	is albuminoid N.
and	19·2	is non-albuminoid.

Silage from Croydon Sewage Farm.

	per cent.	
Water	84·41	
Total N. in dry matter	2·66	
Albuminoid N. "	1·57	
∴ of the nitrogen	41·0	is non-albuminoid.
and	59·	is albuminoid.

Unfortunately we have no analyses of the green foods, as they were put into the silos, and consequently no means of judging whether a reduction of the albuminoids into amides, or similar non-albuminous compounds, did take place during the process of ensilage.

With regard to the loss which green fodder no doubt sustains during the process of ensilage, I may state that no quantitative

experiments have been made in England, and no reliable data have been obtained from which the degree of loss may be calculated. That the loss is greater in making sour than sweet silage, can hardly be doubted. In the preparation of sweet silage, active fermentation does not take place, and in consequence the sugar and other fermentable constituents of green food are subject to much less change and suffer less loss than when the silage is allowed to pass through a prolonged series of fermentative processes, during which the sugar and other carbohydrates in the green food are broken up and their elements re-united into new combinations, which are partly gaseous, and pass away altogether.

In Germany, however, Professor H. Weiske, of the Experimental Agricultural Station of Proskau, as long ago as 1873, made a number of comparative quantitative analyses of green fodder-crops, and the silage produced from them, from which this accurate observer concludes that, in consequence of prolonged fermentation, green food in the process of ensilage is converted into sour silage at the expense of a considerable amount of the dry substance of such food, which passes off mainly in the shape of carbonic acid. The loss thus incurred, according to Professor Weiske, in an ensilage experiment with sainfoin amounted to 28 per cent. of the dry substance of the food. He found that the loss was not confined merely to the sugar and carbo-hydrates, but extended also to the albuminous compounds, and even to the woody fibre. The loss in each of these per 100 parts was:—

Albuminous compounds	16·3
Assimilable carbo-hydrates	39·2
Crude fibre	21·2

Similar results were obtained by Professor J. Moser in his ensilage experiments on green maize, and quite recently by Professor M. Maercker in experiments which he made for the purpose of determining the changes which beet-root pulp undergoes when pitted. In this case the loss by fermentation and gaseous disappearance amounted to nearly 50 per cent. of the dry substance. The experiments of A. Mayer and L. Brockema also confirmed the foregoing observations, and showed that green fodder when undergoing ensilage sustains a very considerable loss.

Professor Weiske and B. Schulze were lately engaged in extending their former experiments, and published in the 'Journal für Landwirthschaft,' Band xxxii. Heft i. 1884, edited by Professors Henneberg and Drechsler, of Göttingen, an interesting report on the changes and losses which take place in green fodder when converted into sour silage.

Without entering into a detailed account of their experiments,

I may quote two examples, of maize and of lucerne, proving that these, like other fodder-crops, experience a considerable loss in food-constituents.

In experiments with green maize, results were obtained from which the losses were calculated as follows:—

		Organic Matter.	Mineral Matter.
		kilogrammes.	kilogrammes.
100 kilogrammes green maize, dried at 212° Fahr.	containing ..	87·82	12·18
gave			
73·9 kilogrammes of sour silage, also dried at 212° Fahr.	" ..	65·29	8·61
26·1 kilogrammes loss during ensilage	" ..	22·53	3·57

These losses were distributed among the chemical constituents as follows:—

		Albuminoids.	Chlorophyll and Organic Acids (Ether Extract).	Crude Fibre.	Soluble Carbohydrates.	Ash and Sand.
		kilogrs.	kilogrs.	kilogrs.	kilogrs.	kilogrs.
100 kilogrammes green maize, dry	contains	9·50	2·14	33·89	42·29	12·18
73·9 kilogrammes sour silage, dry	"	5·91	9·92	23·93	25·53	8·61
26·1 kilogrammes loss in dry matter	"	−3·59	+ 7·78	−9·96	−16·76	− 3·57

The gain in the extract by ether is due to the conversion of sugar into lactic, butyric, and other organic acids, which are soluble in the ether, whereas the sugar from which they are derived is insoluble.

Similarly, in the case of lucerne, we have:—

		Organic Matter.	Mineral Matter.
		kilogrammes.	kilogrammes.
100 kilogrammes green lucerne, dried at 212° Fahr.	containing ..	90·79	9·21
gave			
72·9 kilogrammes of sour silage, also dried at 212° Fahr.	" ..	64·58	8·32
27·1 kilogrammes loss during ensilage	" ..	26·21	0·89

These losses being distributed as follows:—

	Albuminoid.	Chlorophyll and Organic Acids (Ether Extract).	Crude Fibre.	Soluble Carbohydrates.	Ash and Sand.
	kilogrs.	kilogrs.	kilogrs.	kilogrs.	kilogrs.
100 kilogrammes green lucerne, dry	26·69	4·44	22·54	37·12	9·21
72·9 kilogrammes sour silage, dry	16·95	6·41	20·43	20·79	8·32
27·1 kilogrammes loss in dry matter	− 9·74	+ 1·97	−2·11	−16·33	−0·89

I am now engaged in carrying out experiments on silage at Crawley-mill Farm, Woburn; and also on a larger scale at Heath Farm, Woburn Park, where the Duke of Bedford has lately erected several silos. These experiments have special reference to the influence of temperature on the quality of the product, and to tracing the changes and ascertaining the losses which various kinds of green food undergo during the process of ensilage. These results I hope to be able to publish before long in the 'Journal of the Royal Agricultural Society of England.'

12, Hanover Square.
August, 1884.

XVII.—*On the Quality of Creosote suitable for protecting Hop-poles, Wood Fences, &c., against Decay.* By Dr. Augustus Voelcker, F.R.S., Consulting Chemist to the Society.

Commercial creosote, a dark-brown thickish liquid, strongly smelling of carbolic acid, has been used for years past, as is well known, with much success, for protecting from decay hop-poles, stakes, and wooden railings, which, being made from young and more or less immature or green wood, enter into decay, and become rotten and useless, after a few years, especially on naturally stiff and imperfectly drained land.

The creosoting process has been found so efficacious that it has almost completely superseded the older plans of impregnating wood with corrosive sublimate, as in Kyan's process, or with sulphate of copper, sulphate of iron, chloride of zinc, or other metallic salts.

Recently, however, several complaints have reached me re-

specting the quality of creosote with which my correspondents were being supplied. The creosoting liquid, it was alleged, when applied exactly in the same manner as in former years, entirely failed to protect hop-poles against decay; and Mr. F. de Laune, to whom the merit is due of having used crude commercial creosote for preserving timber more than a dozen years ago with great success, and of having introduced this protecting liquid to the notice of farmers in his article in the Journal of this Society, vol. xviii., Part I., p. 259, goes so far as to say that, according to his recent experience, wood impregnated with creosote supplied to him a year or two ago became rotten more rapidly than he believes it would have been had it not been subjected to the creosoting process.

Mr. de Laune's experience in past years, of having creosoted wood with entire success, compared with his recent failures, presents strong presumptive evidence of the quality of commercial creosote having become deteriorated of late years in some cases to an extent such as to make it unsuitable for the preservation of hop-poles, wooden railings, &c.

Unfortunately we possess no analytical data upon which a reliable opinion can be based respecting the quality of the creosoting liquid which ten or twelve years ago, and even earlier, had been used most satisfactorily. It is therefore impossible to make a comparison of the chemical composition of the creosote used in former years with great success with that supplied in recent years, and alleged to be altogether inefficacious as a means of protecting timber against decay.

The liquid used for creosoting timber, known commercially as creosote, is a fluid possessing a highly complex and variable composition.

It is obtained from coal-tar, which, according to the kind of coal from which it is produced, yields the following products on distillation at a temperature rising to about 760° F.

1. Pitch, remaining behind in the retort on distillation, and constituting the largest proportion of the products of distillation.
2. Naphtha, or benzol, the most volatile of the coal-tar constituents.
3. Ammoniacal liquor, which always mechanically adheres to or is mixed with the more specific tar-products of commercial coal-tar.
4. Light and heavy oils of tar.

The latter amount to from 20 to 30 per cent. of the coal-tar, and constitute the creosoting liquor which is used for preserving timber.

Commercial creosote, in other words, is the portion of coal-

tar which comes over on distillation between the temperature of about 350° F. and that of 760° F. It has a highly complex and variable composition.

Amongst its constituents may be mentioned: phenol or carbolic acid; cresol or cresylic acid, closely allied in character to phenol; naphthaline; light tar-oils, passing over on distillation at a temperature of about 600° F.; heavy tar-products which remain behind in the retort at that temperature, viz., pyrene, chrysene, leucoline, cryptidine, pyridine, acridine, and other organic bases which occur in minute quantities in commercial creosote.

The products of distillation of the liquid employed for creosoting wood are heavier than water, whilst the distillation products of animal and vegetable oils and fats, such as bone-oil, palm-oil, cotton-seed oil, resin-oil, and also shale-oil, have a lighter specific gravity than water.

Carbolic and cresylic acid, distinguished for their powerful antiseptic properties, were until recently regarded as the most valuable constituents of creosoting liquids, and are still held by some of the highest chemical authorities as the chief constituents upon which the efficacy of commercial creosote as a preserver of timber mainly depends.

This generally received opinion has been called in question by Mr. Boulton, of the firm of Burt, Boulton, and Hayward, the well-known tar-distillers, who, in a paper read quite recently before the members of the Institution of Civil Engineers, on the strength of certain practical experiments, a long experience, and the testimony of several chemical experts, endeavoured to show that the efficacy of tar-acids as antiseptics has been overrated at the expense of the more stable and enduring properties of the tar-oils. At the same time Mr. Boulton admits that the percentage of tar-acids in the creosote to be used remains a contested matter of opinion.

Notwithstanding all that has lately been said and written in favour of Mr. Boulton's view, it appears to me a hazardous proceeding to rely on the efficacy of a creosoting liquid which contains as little as 3, 4, or even 5 per cent. of crude carbolic acid.

In preserving old well-matured timber, such as is used for railway sleepers, and is less liable to perish than young immature wood, used for railings, hop-poles, and light wooden structures, creosote which is comparatively poor in crude carbolic and cresylic acid, but which is rich in heavy tar-oils, I can conceive may be quite efficacious in preserving such old timber; but when we have to deal with young immature wood, full of sap, I do not think a creosoting liquid, containing as little crude carbolic

acid as I have found in creosote recently purchased, can be relied upon for its power of preventing the decay of hop-poles for a reasonable number of years.

Creosote, suitable for preserving hop-poles or wooden fences, in my judgment should contain not less than 10 per cent. of crude carbolic and cresylic acid; and if the percentage of these tar-acids rises above 10 per cent., the creosote will be all the better for the purpose of protecting the poles against decay.

In a sample of commercial creosote sent to me for analysis a short time ago, I found no less than 14·76 per cent. of ammoniacal water.

This sample, on distillation up to 610° F., yielded only 39·08 per cent. of products volatile at that temperature, including only $4\frac{1}{2}$ per cent. of crude carbolic acid. The ammoniacal liquor, amounting to $14\frac{3}{4}$ per cent., is most objectionable; and $4\frac{1}{4}$ per cent. of crude tar-acids appears to me insufficient to neutralise the effect in the sap of young wood of those constituents which cause in wet ground its rapid decay if unprotected. There can be little or no doubt that a creosoting liquor of the character of this sample is altogether unsuitable for the purpose for which it was used.

Not quite so bad, but still anything but good creosoting liquors, were two other samples, recently purchased by hop-growers in Kent. These samples contained respectively:—

	No. 1.	No. 2.
Distillate from boiling point to a temperature of 610° Fahr.	39·08	61·75
Including:—		
Crude carbolic acid	3 per cent.	4 per cent.
Specific gravity of creosote at 60° Fahr. ..	1·102	1·103

I fear, under the name of creosote, tarry liquors are often sold to hop-growers which are not worth much, if anything, for protecting hop-poles against premature decay; and I would strongly urge upon farmers who are in the habit of creosoting wood not to buy any creosote unless it is guaranteed of a well-defined quality.

The Crown agents of the Colonies, the War-Office, and probably other Government Offices, in entering into contracts for the supply of creosote, issue specifications to govern the quality of supplies of creosoting liquors. Tar distillers and dealers in creosoting liquors surely ought to know what they are selling, and farmers will do well to insist upon being supplied with creosoting liquor of a guaranteed quality. I would suggest the

following specification, the adoption of which, I believe, would place dealings in creosoting liquors on a more satisfactory footing, and remedy the complaints which have lately been made respecting the bad qualities of creosote.

Specification to govern the quality of supplies of Creosoting Liquor.

1. The liquor must be free from the admixture of any oil or other subtance not obtainable from the distillation of coal at temperatures between about 350° F. and 760° F.
2. It must yield from 65–70 per cent. of products when distilled from its boiling-point to 610° F.
3. By repeated agitation with successive portions of a solution of caustic soda of spec. gravity 1·125 (25° Twaddell) the distillate must yield not less than 10 per cent. of crude carbolic and cresylic acid (crude coal-tar acids).
4. The creosoting liquor shall contain not less than 20 nor more than 30 per cent. of constituents that do not distil over at a temperature of 610° F.
5. It should become completely fluid when raised to a temperature of about 95° F., and remain so on cooling down to a temperature of 85° F.
6. The specific gravity of the liquor must not be less than 1035, and not more than 1065, water being 1000 at a temperature of 60° F.

XVIII.—*The Farm Prize Competition of* 1884. By John Coleman, York.

Judges.

Richard Stratton, The Duffryn, Newport, Mon.
George Street, Maulden, Ampthill, Beds.
John Coleman, York.

In connection with the Shrewsbury meeting, the offer of prizes for farm competition was restricted to the counties of Salop, Stafford, and Hereford. As was the case at York the previous year, the Local Committee differed in opinion as to the expediency or desirability of offering prizes, and it was only after considerable pressure had been exercised by influential county representatives that this valuable feature of the Society's annual programme was once more maintained. Bearing in mind the composition of the executive portion of a Local Committee, and the necessarily large proportion of town representatives, whose interests are mainly local, and who are naturally inclined to view the spending of money outside their own boundaries as

undesirable, it is questionable whether a matter of such proved interest and value to the general body of members should be optional with the Local Committee at all. For though public opinion has on these two occasions overborne local feeling, it may not always be so energetically or skilfully directed. And the suggestion thrown out by Mr. Jasper More at the General Meeting in London in December last, that in future the offer of prizes for farm competition should be compulsory on the town which is visited, is certainly deserving of consideration, as it would ensure a continuance of this most desirable element, and would remove all uncertainty from the minds of would-be competitors. Those through whose exertions the farm-prize competition has been maintained will, we trust, feel that the result fully justifies their efforts ; and that the information contained in Mr. Bell's admirable report of farm practice in Yorkshire, and the following effort to convey a faithful account of what we saw in the course of our inspections of the competing farms in the Midlands, will have due effect in strengthening public opinion as to the desirability of making this a permanent feature in the annual role of utilities carried out by our Great National Society.

As will be seen from the appended list, the entries were more numerous than on any previous occasion. The competition in the first two classes for Grass and Arable Farms was excellent, and quite sufficiently close. In the small farm division we are sorry to report only two entries, as, judging from the great interest attaching to them, and the variety of practice they illustrated, it would have been desirable to have seen more of the sort, and especially representatives of the wilder hilly districts.

Those who are acquainted with the geological features of the counties will realise that our work lay principally on the Old and New Red Sandstone formations, and though the surface-soils were seldom derived directly from either rocks, the superficial beds when of a drift character partook of the characteristics of the parent source. The exceptions were a couple of farms on the Wenlock shales. The soils on the sandstone formations are, though variable to a degree, speaking generally, of a fertile character ; the lighter parts very suitable for arable cultivation, and the stronger soils capable of growing good grass under skilful treatment. If we add to this a mild and rather moist climate, and a due proportion of grass to arable, we have some of the conditions which have been so far favourable to farming during recent years, so that there are few signs of that terrible depression which has left an all but ineradicable mark on many less favoured localities. But the great reason for this happy

TABLE I.—LIST OF ENTRIES.

	Acreage.	Nature of Soil as Entered in Certificates.	Awards.
CLASS I.—For the best-managed GRAZING or DAIRY FARM, above one hundred and fifty ACRES in extent, at least two-thirds in PERMANENT GRASS.			
R. Lloyd Acton, of Brockton, Much Wenlock	304	Heavy	Commended.
John Batho, of Winston, Ellesmere	290	Light and Heavy	2nd Prize, £25.
S. T. Glover, Totmanslow Farm, Tean, Stoke-on-Trent	171	Most Strong.	
Henry Hardeman, Woofferton, Brimfield, R.S.O., Ludlow	165	Light and Heavy	Commended.
Charles Holme, Hill Farm, Stafford	415½	Heavy and Strong	Highly Commended.
Thomas Marston, Letton, Brampton Bryan, Herefordshire	312¼	Rather Heavy.	
John Mellings, The Pools, Bromfield, Ludlow	253¾	Heavy	Highly Commended.
William Nunnerley, Dearnford Hall, Whitchurch, Salop	187	Light generally	First Prize, £75.
CLASS 2.—For the best managed ARABLE FARM, above one hundred and fifty ACRES in extent, less than two-thirds PERMANENT GRASS.			
Evan Bebb, Gravel Hill, Shrewsbury	330	Gravel and Loam.	
Mary Bond, Manor Farm, Draycot-le-Moors, Stoke-upon-Trent	192	Medium.	
Peter Davies, Dean Park, Tenbury	475	Heavy Red Clay.	
Thomas Goodwin, Huntington Court Farm, Hereford	312	Inclined to be Light.	
Thomas John Griffin, Preston Vale Farm, Penkridge, Stafford	285	Nearly all Heavy	Highly Commended.
Francis Hawkins, Sugwas Farm, Hereford	532	Light	First Prize, £75.
Ann Jefferies, Bolas Magna, Wellington, Salop	185	Medium, some Light.	
John Mellings, More Farm, Bishops Castle	335	Variable, Clay and Gravel.	
Thomas S. Minton, Montford, R.S.O., Salop	540	Light	Third Prize, £15.
Joseph Pearce, Welbroughton Hall, Newport, Salop	374	Part Light and part Heavy	Second Prize, £25.
Myles Woodburne, Kenwick, Shrewsbury	400	Light, some Peat and Clay amongst it.	
CLASS 3.—For the best-managed FARM, under one hundred and fifty ACRES in extent.			
Charles Miles, Tattenhill, Burton-on-Trent	127	Light and Heavy	First Prize, £50.
Alexander Sherratt, Oclepitchard, Hereford	130½	Heavy	2nd Prize, £15.

state of things is the prominent importance of live-stock in the systems of farming, and this of mixed sorts. The development of the Shropshire sheep from local to national importance, a progress which has been mainly due to the pluck and perseverance of the tenant-farmers themselves, has greatly increased the returns from the flock. The cultivation of cattle either for grazing or dairy purposes—both excellent of their kind and for their respective offices—and much attention to the breeding of a serviceable selling class of cart-horses, have all tended to returns for live-stock much above the average. It is quite evident from the Agricultural Returns, and from my own observation, that the necessity for returning to grass the less desirable tillage-land has been fully realised by the more intelligent occupiers, and that their commendable enterprise has in most cases been met by reasonable assistance from landlords. The following comparison of the area under grass in 1868 and 1883 will sufficiently prove this point:—

	Total Cultivated Area.	**1868.** Area in Grass.	**1883.** Area in Grass.	Increase of Grass.
	Acres.	Acres.	Acres.	
Shropshire	712,846	340,909	422,576	81,667
Stafford	604,237	340,112	404,655	64,543
Hereford	445,842	213,517	334,763	121,246

In the course of the report many instances will be given of successful laying down of land to grass, and I would here only allude to the important influence in obtaining a close thick sward of sheep-grazing when supplied with cotton-cake or other food rich in manuring elements. It has been laid down in some quarters authoritatively that young pastures should not be grazed with sheep; and the reason given is that, eating so close to the ground, they will destroy the clovers. This might be the case if the land were too heavily stocked and the sheep had nothing to improve their manure; but it is most certainly not the case under judicious management, and, though mixed stock are desirable in order that all the herbage should be equally consumed, yet I am satisfied that sheep will do most good, because they are the best manure distributors; and that, whether we are dealing with new pastures or old grass, the most practical and profitable means of improvement is the consumption of cotton-cake by cattle and sheep on the land; and that though, in dealing with exhausted or neglected land, applications of purchased manures, and, on some soils especially, of phosphates, may be desirable—nay, actually necessary—the best and cheapest

way of maintaining fertility is by the free use of cake or other suitable artificial food.

It is not only in the matter of laying down land to grass that landlords have entered into, and apparently understood, modern requirements. We were greatly pleased with the general character of the farm buildings, not only on the farms entered for competition, but throughout the localities we visited. I may describe them as convenient, substantial, and generally adequate to requirements. In only one instance did we see buildings entirely covered in, viz., those at Mr. Marston's farm at Brampton Brian, which, though erected many years since—viz., in 1868—when requirements were less understood, were excellently arranged and greatly appreciated by the tenant, who did not find that the protection thus afforded to his well-bred Herefords rendered them more delicate or less able to thrive in that somewhat exposed country. Though the covering of the yards is not yet in fashion, as we believe it must eventually become, yet in all modern additions the necessity for deep shelter sheds is fully recognised, and the importance of preserving manure as much as possible from the washing of rainfall by having buildings well spouted, and by utilising the drainings of the yards when the lie of the land allows of surface irrigation, were all matters of consideration. Without being invidious, I may notice as especially creditable as regards equipments the estates of Earl Brownlow, some of whose homesteads verge on the extravagant, Earl Powis, the Dukes of Sutherland and Cleveland, Lord Stafford, Sir Thomas Boughey, and The Honourable Mrs. Cotton. It is quite certain that, where the owner takes an interest in his property or is represented by a practical man of business, who knows what is wanted at the present day, and how the outlay can be made that shall benefit all parties, tenants are encouraged to spend their money and take a pride in doing justice to the land.

I may preface a few introductory remarks by a comparison of the returns of live-stock in 1868 and 1883, from which the increase of horned stock and the decrease of sheep will be evident:—

	Shropshire.		Staffordshire.		Hereford.	
	1868.	1883.	1868.	1883.	1868.	1883.
Cattle	120,786	143,651	125,046	137,402	71,181	81,978
Sheep	519,539	342,486	365,945	225,576	380,607	270,463
Pigs	61,220	69,501	53,788	54,180	28,942	31,691

The large decrease of sheep is partly attributable to the fact that, owing to the ravages of the rinderpest in 1865 and following years, sheep-stock had to a certain extent replaced cattle-stock for a time, and the increase of the latter is partly explained on the same principle; but it must also be remembered that the increase of grassland must have a tendency to reduce sheep-keeping facilities, and increase the means of keeping cattle. The present large deficiency in the numbers of sheep, as compared with 1868, may also be in some measure owing to the losses from liver-rot in the wet seasons of the last decade. The numbers of both stock have sensibly increased in the last year over its predecessor, and we may with favonrable seasons look for further development.

Throughout Shropshire and Herefordshire the prevailing breed of cattle are Herefords, and the improvement of these valuable animals has been greatly stimulated since the Herd-book was established (mainly through the exertions of Mr. Duckham, M.P.). The American demand, which has been going on for some years, is as active as ever, and, according to the opinions of Americans themselves, may continue for years to come. Quite recently this demand has extended to South America; thus opening out a vast field for the future. It was indeed fortunate for the breeders that they got their animals registered, for our friends across the water will not as a rule look twice at an animal, however meritorious, that is not proved to be pure bred by the Herd-book. Any lengthy description of the Hereford cattle would be out of place; their great size, early maturity, splendid beef-producing qualities, and hardy character, are well known; their weak point is in yield of milk, though what they do give is rich. The universal practice of turning out the calves with their dams, and either not milking at all or only taking away any excess during the first weeks of the calf's life, is not calculated to encourage or develop milking qualities, because it is well known that, if the whole of the milk is not abstracted, the flow rapidly reduces, and, as the calf learns to eat grass, it naturally cares less for the teat. There are other reasons why we question the wisdom of the system. The returns from ordinary stock are not sufficient. The total value of the cow's produce consists of the price of the calf when weaned, say at 8 to 9 months old, which may range from 10*l.* to 12*l.*, and this includes the grass eaten by the calf as well as its dam—no inconsiderable item; whereas, in the best dairy management, a return is obtained per cow of more than double, although, of course, expense of management is greater. Hereford cows are wintered without much expense; indeed, in sheltered situations, they may live out most of the year, having a shed to lie in at

nights, a few roots thrown about or sliced, and straw; the labour of milking is also saved; but highly-fed dairy stock, whether kept for milk-selling or cheese-making, must do much more as manure-makers and land-improvers than cattle which get no extra food. One of the Judges, himself a milkseller, contends that the system is prejudicial to the milking qualities of the future cows, inasmuch as the animal becomes far too fat, and, though this condition is the result of natural food, yet the result is just as bad as though the calf was forced for show, proper muscular action being seriously impeded by the deposit of fat in the tissues. I had no opportunity of instituting a comparison as to fecundity between Hereford heifers and hand-reared stock, but I can readily imagine that his views are sound in this matter. In almost every instance where Herefords were kept we found one or two dairy animals purchased to supply the requirements of the household; and, lastly, whilst precluded from giving actual figures, I am justified in stating that the system, as applied to cattle of ordinary market value, is not sufficiently profitable. Nothing could be more satisfactory than the progress of the stock when weaned; they thrive splendidly in open yards, are docile in habits, and when judiciously fed, without an excessive quantity of roots, and with a due allowance of concentrated food, their progress is rapid; and they probably pay as well for their food as any breed of similar age. I venture to suggest that, under different treatment, the milking properties of the Herefords might be developed without serious injury to their feeding qualities. In one instance, not that of a competitor, I found cross-bred cows each rearing two calves, and I am convinced that, even if dairying is not considered practical or desirable, more should be done in the way of rearing. I am diffident about criticising established practices, for which there may be reasons beyond my ken; but, as it is said that onlookers often see more than those at work, so perhaps the expression of my convictions, which have been forced upon me by observation and facts, may at least provoke useful consideration.

Much of the success, which we witnessed with admiration and almost envy, is attributable to the valuable rent-paying properties of the Shropshire sheep, which are universal in the Midlands. The characters of these are too well known to require description; but I may notice the fact, that the practice of shearing the lambs in July is becoming general, and, as far as I could gather, is considered desirable, because the skin can be kept cleaner and insects more easily destroyed. Another innovation, as to which the testimony was more varied, is the putting of the forwardest ewe lambs to the ram. On good land, and with generous

treatment, I believe this will be found advantageous, as saving time, bringing the animal into profit at an earlier period, and probably causing them to breed better in the following year. The experience was very varied. In one case, where the land was strong and the animals kept only in moderate condition, only 2 out of 20 proved in lamb, and these cast their lambs; whilst in another every one produced a lamb; and these, at the time of our second visit, were thriving and looking well. I think the system might be more successful if the management of the lambs included the use of a small quantity of artificial, and a greater change of natural food. In this way they would be more developed; and the wethers might be sufficiently forwarded to be fit for the market at a year old: whereas, the almost universal practice is to finish them off on grass-land or seeds during a second summer. I cannot think that this is judicious, as more holding stock might be kept if the hoggs were finished off on turnips.

Another practice, not universal but very general, was the carting to the homestead and the grass land of the whole of the root-crop, often at great cost, and carting back manure made from the consumption of the roots by store cattle eating straw. Where strong land prevails this may be a necessary evil, but it is certainly not desirable where the land is suitable for eating on. In one case, where the land was eminently suitable for sheep, the occupier admitted that formerly sheep consumed a part of the crops on the land, but he had got out of the practice and he could not tell why. In my opinion it would be more profitable to consume the bulk of the roots on the land; and if such treatment is likely to make the land too rich for barley, then take wheat first, and follow with barley, by which process it is probable that the tendency to clover-sickness, which is so very often the case, would be obviated, partly by increasing the interval and more by improving the condition of the land; for we found excellent crops, even though recurring at intervals of four years, in every case where the land was in really high condition.

We were very much impressed with the economical management of labour, the cost, which will be given in every case described, will, we think, compare very favourably with most parts of the country. This is due to the thorough knowledge of work by the employers, and to their own exertions either in careful superintendence, or in active assistance. Thus it will be noted that on one of the dairy-farms, although not by any means a small undertaking, the farmer always makes one of the milkers, and the wife is the dairymaid. With such personal attention, no serious difficulty is experienced as to milking, which in some parts of the country is becoming a great trouble.

In the south of Shropshire, and throughout Herefordshire, orchards occupy a considerable area, and cider-making is an important feature. Generally the juice is expressed by revolving stones, similar to a mortar-mill. In one instance, that of Mr. Peter Davies, of Tenbury, an American mill is used. A short description of the process may be interesting. The fruit, which is shaken off the trees when ripe and allowed to remain in heaps for a time in order to further mature—though care should be taken to avoid decomposition—is put through the mill, which consists of a drum running at about 2000 revolutions per minute, working against a set of lever rasps or scrapers, which give way if a stone or other hard substance gets into the mill. The pulp is next filled into hair bags, pressed in a Bulmer press, then placed in water to macerate for 24 hours, 6 gallons of water to each hair; * then reground, repressed, and the liquid added to the first expressed juice. Underneath the manufactory is a large commodious cellar. The juice is run by flexible tubes into barrels holding 400 to 500 gallons each, where the fermenting process takes place. On this farm of 475 acres there are 42 acres of orchards, mostly in grass, and producing very useful keep for sheep and cattle. The waste pulp is usually thrown about the orchards and consumed by stock, and what is uneaten makes manure. The crop is very uncertain. That of 1883 was very abundant, and was estimated at 14,000 gallons, which at 6*d.* a gallon, an average price in good years, equals 350*l.*, about 8*l.* 10*s.* an acre, besides the value of the grass, which is certainly not less than 1*l.* 10*s.*, making a total gross return of 10*l.* an acre; but this is of course much above the average, and the cost of manufacture is considerable. It may be taken as a general rule that a well-stocked orchard, with trees in good bearing, is worth about 5*l.* an acre. In every case where cider was made, and in some instances where it was bought, it forms part of the wages, a custom which, to our minds, would be more honoured in the breach than the observance; and in many instances the farmers were of the same opinion as ourselves; but the tyrant custom has been hitherto too strong for them. Mr. Davies, for instance, gives his men the option of 2 quarts a day throughout the year, or 1*s.* 6*d.* a week additional money. Almost universally liquor is preferred. The consumption averages 250 gallons a month, with an additional 500 gallons in harvest, that is, 3500 gallons a year, at 6*d.* a gallon, 87*l.* 10*s.* Another large grower tried money for a time, but such was the dissatisfaction that he had

* This is the technical name of the bag, made of coarse hair, in which the pulp is placed for the press.

to return to the system, although sensible of its evil tendencies. On some farms we found 2 quarts given in winter and 3 quarts, which not unfrequently extends to a gallon, in summer. Such an enormous quantity of acid must be injurious, and there is no doubt that cider-drinkers are more subject to rheumatism than others. Seeing how almost entirely money has been substituted for drink in many parts, and the advantages to all concerned which follow, we think that in these days of combined action by means of clubs and chambers, a well directed agitation might be effectively worked, and the cider evil—for such it is—done away with. Labour should be paid for in money only, with liberty to buy, up to a reasonable limit, at 6*d.* a gallon.

Through the courtesy of Mr. Davies, Sen., now retired in favour of his son, who entered on the same farm in 1822, I am able to give a most interesting comparison of the amount and value of stock which the farm carried at the two periods, the area, 475 acres, being the same; but at present 17 acres are occupied with hops, and therefore to this extent the stock-bearing area is reduced. The facts are obtained from a sale catalogue when the farm was given up by Mr. Edward Farmer, and represents, according to Mr. Davies, Sen., the full capacity of the farm for stock. Indeed, he declared that for some years after his entry he could not keep more; possibly so soon after the close of the great European wars there would be a larger proportion of arable land than at present. The horned cattle of the Hereford breed comprised 9 cows and calves, 5 three-year-old heifers in calf, 8 two-year-olds, 3 barren cows, 4 three-year-old bullocks, 4 two-year-old bullocks, 6 yearling heifers, and 6 yearling bullocks, making a total of 45, which realised the magnificent sum of 140*l.* 1*s.* 3*d.*, or a trifle over 3*l.* a head average. The highest price for a cow and calf was 11*l.* 15*s.* Three-year-olds ranged from 7*l.* 5*s.* to 8*l.* 10*s.* Three-year-old bullocks made 8*l.* 10*s.* each. Two-year-old heifers in calf ranged from 2*l.* 6*s.* to 18*l.*; yearlings from 2*l.* 17*s.* to 4*l.* The working horses comprised 6 animals, which ranged from 2*l.* 10*s.* given for a six-year-old mare in foal and 13*l.* 10*s.* for a five-year-old. The hackneys included 8 animals, 2 not sold; prices from 4 guineas to 15 guineas. The sheep were sold privately. They comprised 58 ewes and lambs, 16 yearling ewes, 21 wethers, and 9 rams, making a total, irrespective of lambs, of 104 head, which would probably have made an average of 1*l.* 10*s.* a head, at which I have calculated them. Pigs, 15 in number, ranged from 1*l.* 16*s.* to 3*l.* 15*l.*, and approached nearer present prices than any other kind of stock.

The particulars of the sale catalogue may be thus summarised:—

			£	s.	d.
45	head of cattle		140	1	3
6	waggon horses	£50 10 0			
7	hackney „ &c. ..	81 12 0			
			132	2	0
104	sheep, estimated at		156	0	0
15	pigs		23	5	0
	In 1882, total value of live-stock ..		£451	8	3

At the time of our first visit in January, the stock of cattle comprised—

23	in-calf cows, well-bred Herefords, valued at 22*l*.	£506
1	dairy cow, cross-bred	25
15	feeding bullocks and heifers, at 20*l*. each..	300
17	yearlings, at 12*l*...	204
3	yearling heifers for breeding, at 15*l*... ..	45
9	cows, two-year old heifers, at 18*l*.	162
3	feeding cows	60
1	three-year-old bull, "The Druid"	30
72	head.	£1332

Horses.

13	working horses, at 30*l*.	£390
2	old mares	30
2	foals	40
2	nags	50
19		£510

Sheep.

126	big Shropshire ewes in-lamb, at 70*s*.	£441	0	0
137	mixed hoggs, at 50*s*...	342	10	0
11	ram lambs, at 80*s*.	44	0	0
3	older rams, at 5*l*.	15	0	0
277		£842	10	0

without pigs, of which we have no record. The following is a summary of the two periods :—

1822.		£	s.	d.	1884.		£	s.	d.
45	Head of Cattle ..	140	1	3	72	Head of Cattle ..	1332	0	0
13	Horses	132	2	0	19	Horses	510	0	0
104	Sheep estimated ..	156	0	0	277	Sheep	842	10	0
162		428	3	3	368		2684	10	0

I have estimated the value of the present stock, and certainly have not in any way exaggerated prices. It shows that the capabilities of the farm as to the number of stock have more than doubled, whilst their value has increased sixfold.

After the first inspection in January, the Judges were able to eliminate five competitors as practically out of the running; and it was decided, in the interests of all parties, that it would be better to indicate to these exhibitors that no further inspection would be made.

For the first time in the history of Farm-prize Competition, the Judges were instructed to make inquiries of competitors as to whether they could recommend any servants as specially meritorious in the discharge of their duties, in order that such might be recommended to the Council for medals or certificates. This departure is in their opinion a very proper one. The really deserving servant would find such a distinction a valuable help to advancement in life; and when it is remembered that some of the most successful examples of farming are by men who have risen from service by the honesty of their work and by their provident habits: any help to the really deserving must be of public advantage.

Class I.—First Prize.

Mr. William Nunnerley, Dearnford Hall, Whitchurch.

Grass	127 acres
Arable	60 „
Total	187

This farm is held on a yearly agreement under the Hon. Mrs. Stapleton Cotton, of Park Hall, Oswestry, Salop. The agreement dates from February 20, 1879; and after the ordinary clauses as to cropping, consumption of produce, &c., the landlord undertakes to expend 300*l.* in bones, to be supplied on or before May, 1879, and 470*l.* in improving the house and buildings, and making the latter accommodate fifty cows, to provide shed and yard for young stock, and a Dutch barn to hold most of the produce. In addition to the above liberal outlay, the landlord contracts to supply permanent seeds for a field of 20 acres. Most of the grass-land has been dressed with ½ ton per acre of bones, from which much benefit was visible. This was followed up last winter by a mixture of bone-meal and superphosphate. The soil is a sandstone drift, of a light, and in some parts thin and poor character, more suitable for tillage than grass; indeed, we believe that without liberal treatment and judicious grazing, the grass would be only second-rate. Some of the lighter tillage

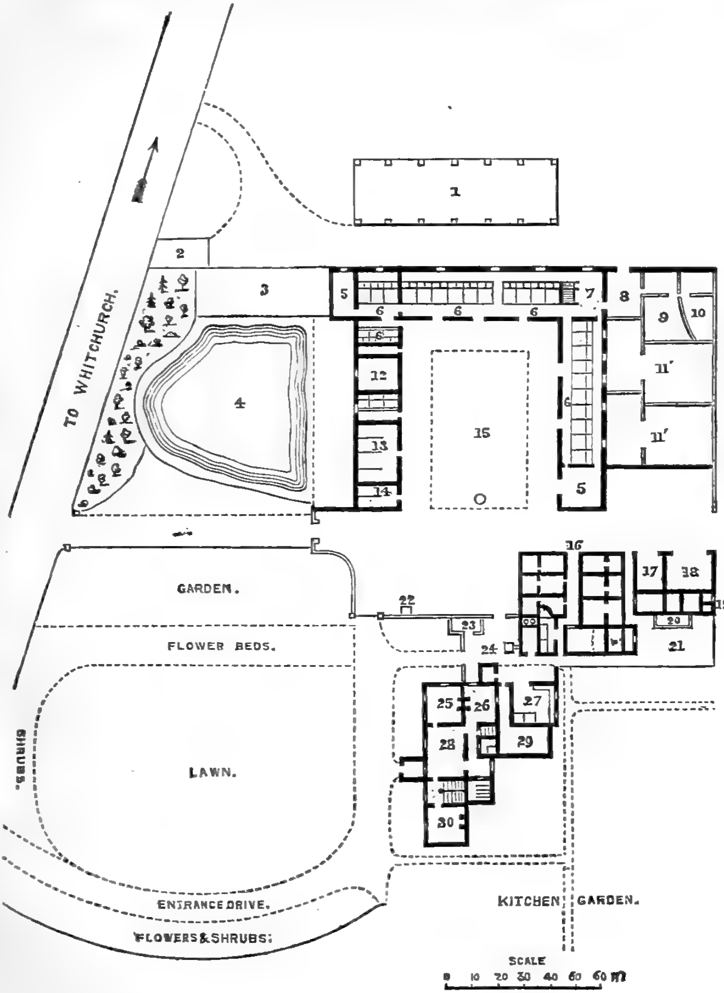
land is plagued with poppies and spurry. Great judgment is exercised as to grazing. Sheep and cows are never mixed.

Live-Stock.—On our second visit in May, we found the following stock, which were almost identical, except in the matter of calves, with what existed in January:—

Cattle.	Sheep.
50 Cows in-Milk.	62 Ewes.
10 Yearling Heifers.	74 Lambs.
13 Heifer Calves.	136
2 Bulls.	
75	
Horses.	**Pigs.**
2 Draft horses (1 Man).	5 Breeding Sows.
1 Strong half-bred horse.	59 Fat and Store Pigs.
1 Nag.	64
4	

Dairy Management.—The plan of the homestead (Fig. 1, p. 521) gives a good idea of the accommodation provided. The great business at Dearnford Hall is dairying, cheese being the principal product. The cows, of shorthorn type, are a capital lot, carefully bred with a view to good milking properties. We were very favourably impressed on our first visit, when the animals were in the stalls; but their great excellence was more evident when we saw them in the cow pasture. There we inspected fifty grand cows and heifers in full profit, and found every animal meritorious. Great care is exercised both in the selection of sires, which are not necessarily, though generally, pedigree stock from milking tribes, and the cows are drafted if they are not quite satisfactory. The heifers, which we thought a capital lot, are served about July and August, so as to produce their first calf when about two years old, and many of these youngsters made a remarkable show for their age. Most of the animals are bred on the farm; a few are occasionally purchased. The cows calve in the spring, mostly before cheese-making commences. All the best heifer calves are reared, and the bull calves are fattened up to the time of cheese-making; after that, they are sold as soon as removable, two or three days old, at from 2*l.* to 2*l.* 10*s.* each. During the winter the cows, although mostly dry, or at any rate not giving much milk, are well fed, viz. long hay or straw, and 56 lbs. of swedes, given whole to the cows, and sliced or fingered for the heifers, with 3 lbs. of mixed cotton- and linseed-cake. In summer, cows in full milk have as much as 6 lbs. a day of decorticated cotton-cake. This extremely liberal scale of feeding explains the extraordinary amount of

Fig. 1.—*Plan of Dearnford Hall Farm Homestead.*



1. Dutch-barn.
2. Shed.
3. Garden.
4. Drinking-pool.
5. Calves.
6, 6, 6. Cows.
7. Mixing-room.
8. Roots.
9. Young cattle.
10. Sows' yard.
11′, 11′. Young cattle.
12. Box.
13. Cart-stable.
14. Hack-stable.
15. Manure yard.
16. Piggeries.
17. Gig.
18. Cart-shed.
19. Closets.
20. Ducks.
21. Yard.
22. Kennel.
23. Coals.
24. Yard.
25. Room.
26. Kitchen.
27. Dairy whey.
28. Hall.
29. Press-house.
30. Dining-room.

stock kept. For though the cows are turned out to grass by the 24th of April, only 75 acres of grass are provided for the summer grazing of 50 cows, 4 horses at night, and the young calves. The heifer calves are always setoned in the breast when from six to eight months old, as a preventive against black-leg or quarter-evil, which was the cause of considerable loss previous to this treatment. Only one solitary case has occurred since. The young cattle are wintered in a well-sheltered yard, with a good shelter-shed suitable for the purpose, and forming part of the alterations carried out on Mr. Nunnerley's entry. Their winter food comprises barley straw, cut turnips, and 3 lbs. of linseed-cake daily. In summer they depend upon their own resources in a good grass field. The cows during winter are tied up in pairs in a well ventilated cowhouse, which is well arranged as to mangers, &c.; but the space, 6 feet, between the stalls is decidedly narrow for large cows; and, as one of the judges remarked, would have been better if 6 inches wider. The weaning calves, 13 in number, were a thriving, coloury lot. We found them in May in a small paddock of excellent grass, close to the homestead, having a little skim-milk, with linseed-cake first soaked in water, sliced mangolds, meal, &c. On the occasion of our second visit we found cheese-making in full swing. A special description of sour cheese for the Manchester market is made, acidity being obtained by adding a small quantity of old (sour milk). Blue mould forms rapidly, and this class of cheese can be sold at from six to eight weeks old. Delicate and careful manipulation is required in the process, but with Mrs. Nunnerley's careful and systematic management success is ensured. About one-third of the cream from the night's milk is removed. This comparatively large proportion is justified by the high condition in which the cows are kept. Indeed, it is probable that the cheese would not be of such uniform quality, and would be more difficult to manipulate, if more cream were retained. The usual price obtained is 70*s.* a cwt. of 121 lbs. In 1882 the price was 66*s.*; in 1883, 70*s.*

Accurate accounts are kept, from which the following facts as to dairy produce for 1882 and 1883 have been supplied:—

1882.	£	*s.*	*d.*
Cheese from 50 Cows	767	12	0
Butter	137	0	0
Whey valued at 50*s.* a Cow	125	0	0
Calves sold	82	18	0
Calves reared, 12 calves 2*l.*	24	0	0
22*l.* 14*s.* 7*d.* per Cow	1136	10	0

1883.	£	*s.*	*d.*
Cheese from 47 Cows	766	2	0
Butter	168	7	4
Whey valued at 50*s.* a Cow	117	10	0
Calves sold	110	0	0
Calves reared, 15 calves 2*l.*	30	0	0
25*l.* 7*s* 2*d.* per Cow	1191	19	4

The foregoing are remarkable figures, indicating results probably almost unique in the experience of cheese-makers. The yield of 1882 was at the rate of 4 cwt. 2 qrs. 22 lbs. per cow. The actual weight of cheese in 1883 was 26,074 lbs., which gives an average per cow of 4 cwt. 3 qrs. 22 lbs. No registry of milk is kept, but the cheese averages as many gallons of milk, inasmuch as a gallon of such milk will undoubtedly make a pound of cheese. Comparing the return of 1883 with that of a milk-selling farm, we must deduct from the total the sum which would be received for calves sold at birth, assumed to be 100*l.*, and we have 1091*l.* 19*s.* 4*d.* as the amount realised for Mr. Nunnerley's milk, which works out a fraction over 10*d.* a gallon.*

In connection with the dairy, and as evidence that the value of the whey has not been exaggerated, I append the pig account for 1883. A capital sort of white middle-breed pigs is kept. At the visit in January we found six sows and produce, and five bought pigs.

	£	s.	d.	£	s.	d.
Amount received for pigs sold				370	14	6
Do. do. extra in stock				6	6	0
				377	0	6
Less cost of pigs bought				80	6	0
				296	14	6
Corn and meal consumed	£118	16	0			
Whey at 50*s.* a cow ..	117	10	0			
				236	6	0
Balance profit				£60	8	6

* As a means of testing the accuracy of the figures supplied by Mr. Nunnerley, he has, at the request of the Judges, weighed the milk yielded on a given day, June 12, 1884, and the cheese produced from it on June 26, 14 days after manufacture.

Total weight of milk from 49 cows and heifers	1785	lbs.
Quantity of cream removed for butter	$19\frac{1}{2}$	„
for cheese-making ..	1765	„
This measured 173 gallons.		
Two cheeses weighed on June 26	171	lbs.
Butter from cream off milk	$9\frac{1}{3}$	„
„ whey	$4\frac{2}{3}$	„
Total	14	„ {or 2 lbs. of butter per cow per week.

The average yield of milk per cow equals $14\frac{2}{3}$ quarts.

The animals comprised 31 adult cows, seven 3-year-old and eleven 2-year-old heifers.

This test was applied after a long drought, and when the pastures were becoming very bare.

The food comprises meal of various kinds soaked in whey. The troughs and feeding shoots of Staffordshire ware are clean, convenient, and economical of food.

A small flock of well-bred Shropshire sheep and their followers are kept as accessory to the dairy, which is the great business of the farm. In January we found 38 ewes and 28 ewe-lambs, the latter having been served. The character of these sheep was very good. They were on grass, getting ½ a lb. of cake. There were also 35 tup-lambs (from which the best had been sold in the autumn for breeding purposes) intended for the butcher, which we found folded on the turnip-field and gnawing the roots, and getting the extraordinary allowance of 1½ lbs. of cake and peas with hay. This was the only weak feature of the management. It must be false economy to make lambs that are shedding their teeth gnaw swedes; either they would not do so well, or they might do better with less food if the roots were cut. When this was pointed out, Mr. Nunnerley at once recognised the force of our objection, and altered his practice, with decided advantage to his sheep. At our second visit we found 61 ewes and 74 lambs. Twenty of the shearlings had proved in lamb, and Mr. Nunnerley was in favour of the innovation, which, with his liberal treatment, will no doubt answer. Not only is there a decided gain in having production fowarded a year, but it is probable that the young ewes will do better the second year. Besides a good pasture, mangolds were supplied, and 1½ lbs. of artificial food per ewe, consisting of a mixture of linseed-cake, undecorticated cotton-cake, Indian corn, and rice-meal. This liberal supply was slightly increased as the lambs commenced to eat. Considering the large allowance of artificial food, the lambs were not so big or so forward as might have been expected, and Mr. Nunnerley thinks that oats instead of Indian corn would have done the lambs better, which we should think probable.

The 60 acres of arable land are farmed mainly on a four-course shift, and the maximum produce of which the land is capable by good cultivation and high manuring obtained.

The following are the yield of various crops per acre:—

1882.	1883.
Wheat 28 bu. of 75 lbs. = 35 bu. of 60 lbs.	Wheat 35 bu. of 75 lbs. = 43¾ bu. of 60 lbs.
Barley 30 bu. of 70 lbs. = 37½ bu. of 56 lbs.	Barley 30 bu. of 70 lbs. = 37½ bu. of 56 lbs.
Oats 45 bu. of 50 lbs. = 53�4 bu. of 42 lbs.	None grown.
Potatoes 9 tons.	Potatoes 11 tons.
Mangolds 22 tons.	Mangolds 28 tons.
Swedes 20 tons.	Swedes 20 tons.
Green Globes 19 tons.	Green Globes 22 tons.

The seeds, from Messrs. James Dickson and Sons, of Chester, generally remain down for one year only. The usual mixture

comprises red clover, alsike, white Dutch, cow-grass, and ½ bushel Italian rye-grass. Field No. 22, 7a. 3r., and part of No. 10, about 6 acres, comprise the seed-break this year. The crop in both cases was as good as possible. In No. 22, the young seeds after barley were top-dressed in the autumn with well-rotted farmyard-manure, followed in December by a mixture of equal parts of bone-meal and superphosphate, at the rate of 5 cwt. per acre, at a cost of 25*s.* Grazed with ewe-hoggs up to Christmas, rested till the beginning of March, then fed by ewes and lambs up to the beginning of May, and with a little rain, there was the certainty of an abundant crop by the middle of July; indeed, given clean land, as this is, and a good plant, it would be a matter of surprise if such treatment did not produce great results. On our last visit, July 10, these seeds were still growing, the rye-grass was just coming into flower, and the clover was partly in flower. One of the Judges, viewing the field from a distance, not unnaturally remarked that it was a splendid crop of barley. We never remember to have seen any crop of such bulk, which we estimated at from 2½ to 3 tons per acre. No. 24, 14a. 0r. 12p., consisting of oats and wheat, were excellent crops, and with a favourable finish must yield very largely. No. 18, 8a. 2r. 1p., was a capital field of awnless barley, quite as much as could stand. The 6 acres of No. 10, not having been grazed since Christmas, and having had, like the others, 5 cwt. of bone-meal, &c., was a sight to see, so thick, full of clovers, and forward. This must cut a big crop whatever the weather might be. At our last visit in July we found a splendid fog grazed with the lambs, having 1 lb. a head of common cotton-cake daily. They had been dipped and dressed with Morris's fly-powder, and were thriving and much grown. The root-break, on the judicious handling of which so much of the success of the rotation depends, occupied this year No. 23, 12a. 4p., and 4 acres of the lower part of No. 10. In the former case, the wheat-stubble was well cultivated, then ploughed with a deep furrow. It was cultivated across in spring and well worked, bouted up, and 10 to 11 tons of farmyard-manure applied, on which were sown broadcast across the drills 4 cwt. of superphosphate and 2 cwt. of guano. Swedes, supplied by Carter and Co., were just peeping when we saw them in May. The land was in splendid condition, as fine as a garden, and perfectly clean. These swedes were much punished by dry weather and fly, but, owing to condition and tilth, pulled through, and were established and growing well in July, promising a first-rate crop. The 4 acres of No. 10 consisted of 2½ acres of Magnum Bonum potatoes grown with a heavy dressing of foldyard-manure, 4 cwt. of kainit, and 2 cwt. of guano, which should secure a crop on this, the lightest and weakest field of the farm, and 1½ acres of

Dickson's Yellow Globe Mangolds, which in May were well up but showing the presence of the old enemy, whose eggs were to be found on the under-sides of the leaves. Not a root-weed could be seen, and the condition of the land was perfect. These roots were nearly meeting in the rows when we saw them in July, their growth having been assisted by a cwt. per acre of nitrate of soda after the first hoeing. The corn of all kinds was looking most promising, dark in colour, thick on the ground, and, save for a good deal of charlock in one field, quite clean, all dressed with nitrate of soda. The barley, about 8 acres, occupying the middle of No. 10, suffered severely from drought, the thin soil not having sufficient moisture; hence the corn had come at twice, was uneven, and could not yield a large crop. This was the only weak crop, and it was owing to circumstances over which the tenant had no possible control; for, in May, this crop was all that could be desired. Admirable as is the management of the arable land, which is mainly worked by two good horses, the greatest credit is, in our opinion, due to Mr. Nunnerley for the excellent and improving condition of the pastures, which are not specially fertile by nature, and which present a very improving appearance. The heavy dressing of bones no doubt did good service, and the large consumption of cake, with the application of bone-meal recently, have all contributed to the present close well-grazed sward. We must particularly notice No. 9, 20a. 1r. 2p., a large cow-pasture which was laid down five years since, the landlord finding seeds, (Sutton's best mixture) with 5 cwt. of bone fertilizer; second year a heavy dressing of well-rotted farmyard manure, and last year 5 cwt. of bone-meal. It has been twice mown, and is wonderfully well knit together, and carries a quantity of stock for its age, which we have never seen exceeded. It is well watered by a stream on one side. We must notice No. 6, 16a. 2r. 11p., which was intended for hay, and promised a good crop; it was grazed up to April 10th, and was then dressed with 5 cwt. of bone-meal and 1 cwt. of nitrate of soda: 5 cwt. of bones was applied five years ago, and it has not been mown since. With seasonable rain, this should have proved a heavy crop of first-rate quality; as a matter of fact, the crop was light owing only to the long dry weather. This, with the 14 acres of seeds, is the usual quantity provided for hay. As a rule, the meadow-land is dressed with 5 cwt. of bone-meal, 5 cwt. of superphosphate, and 1 cwt. of nitrate of soda per acre—a treatment that certainly more than replaces the loss of material withdrawn in the hay-crop.

Labour.—With so much stock, and everything in such excellent order, it is not surprising that the cost of labour per acre is

rather high, and beyond the ordinary range of pasture-farms in the district.

	£	s.	d.	
Wages of labourers	153	6	2	
Servants' wages	67	19	0	
Food for 3 men and 2 women	100	0	0	
	321	5	2	= to 35*s.* an acre.

The outlay for purchased foods and manures in 1883 reached over 650*l.*, made up of—

	£	s.	d.	
Corn and meal ..	317	2	9	Giving an average outlay under these heads of £3 9 0 an acre.
Cake	227	5	7	
Manures	106	3	4	

It will suffice to mention that the valuation of stock and crops on January 1st, 1884, after deducting debts and liabilities, amounts to 2447*l.* 2*s.*, which proves that a working capital of at least 13*l.* an acre was employed, and, though we refrain from publishing actual figures, we are enabled to state that Mr. Nunnerley's intelligent and enterprising management has resulted in highly satisfactory results. Some idea of what is accomplished may be gathered from the fact that the gross receipts from the farm come to between 12*l.* and 13*l.* an acre. The notable point in the management of Dearnford Hall Farm, and which it is desirable should be fully realised by dairy farmers, is the fact, that Mr. Nunnerley makes a larger return by good dairy practice than would be possible by selling milk under the most favourable conditions. That this return is obtained almost entirely in summer, when the cost of production is at a minimum; and that, together with a system of feeding which is equal to that of most milk-farms, he retains on the farm the whey containing most of the mineral constituents of milk; and this and the manure-value of the grain consumed by a large number of feeding pigs, must greatly increase the value of his manure. All this was abundantly evident in the excellence of the crops and the condition of the live stock. There is a danger at the present time that the supply of milk may exceed the demand; indeed, competition has in many instances reduced prices to a point leaving little profit to the producer. It is, therefore, most important to prove that at least equally good returns are possible by first-class cheese and butter farming. In Mr. Nunnerley's management every branch of farm economy shows care and judgment. The land is clean, both arable and pasture. The fences, which were extremely neglected when the farm was taken, are tidy and well trimmed, and are as com-

plete as it is possible to make them. Nor must we omit to notice the beautifully kept and tastefully arranged pleasure and kitchen gardens—fit surroundings to the comfortable and imposing-looking residence, with fine old trees in the background. The buildings, though not in any way special or remarkable, are conveniently arranged, and accommodate the very large stock kept. And with such a highly qualified manager as Mrs. Nunnerley it is almost needless to say that the arrangements of the dairy are admirable.

An extraordinary outlay in labour, food, and manure is incurred, and we may add in rent and rates. Every portion of the work is well done: the land is clean, the stock all good of their kind, and the profits large. The great secret of success is judicious high feeding. Consuming the summer keep in the most economical manner allows of very heavy stocking. The areas of hay crops are small, but the yield is large. It must not be forgotten that one important element is the skill exercised in the manufacturing department, and Mr. Nunnerley is specially fortunate in having in his wife a lady who thoroughly understands and looks after her share of the work. We had the pleasure on our second visit of meeting Mrs. Nunnerley's father, a gentleman who is himself a large dairy farmer, and evidently thoroughly understands his business; and it was evident that Mrs. Nunnerley's training in her important part of the business had not been neglected. May we not add that the business at Dearnford Hall, both outside and inside, does not suffer from the fact that it is in the hands of a lady and gentleman of refinement and education: here, at any rate, there is no evidence that these desirable attributes may not be combined with the most intelligent attention to everyday work. Mrs. Nunnerley makes the cheese, and her husband takes his share of the work outside.

Class I.—Second Prize.

Mr. John Batho, of Winston, near Ellesmere.

Grass	194	acres
Arable	96	,,
Total	290	,,

Mr. Batho occupies on a yearly tenure under the Earl of Brownlow. This is a well-managed dairy farm, where cheese-making is the chief business.

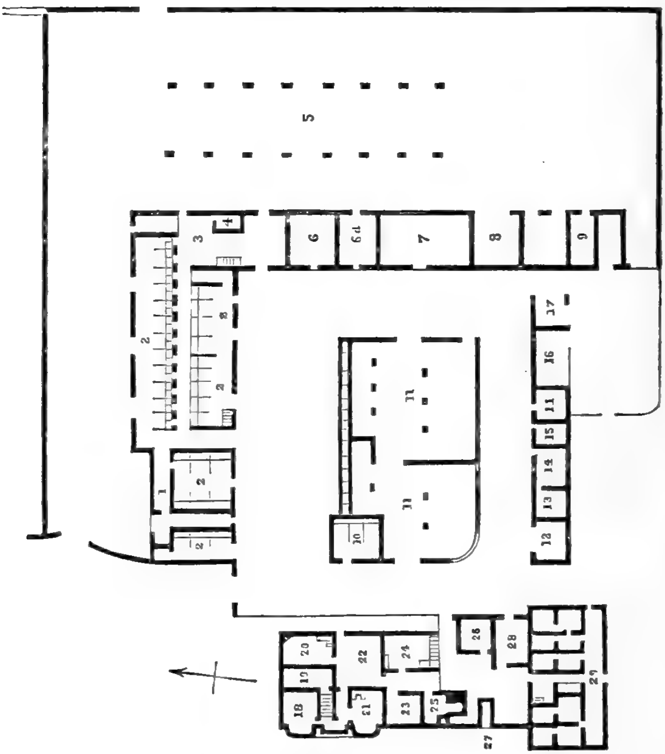
The cows, ranging from 50 to 55, are milked by four girls, two men, and Mr. Batho, who always takes his part, and can

thus see that the work is properly done. The buildings are commodious and well arranged. The cow-houses are roomy and well ventilated, most of the cows in winter being housed in one very big shippon. At the time of our first visit, the tenant was erecting a capital shed, with an iron roof, to shelter two yards. Here we found the only instance of a wind engine, 3-horse power, which, as the buildings are open to every wind, is found very useful, and answers perfectly for grinding, chopping, and pulping. The hopper is large, and, being filled up at night, the work goes on whenever there is wind. There is a large Dutch barn, put up by the tenant. At our first visit, in January, the horned stock comprised 50 cows, 2 bulls, 10 two-year-old heifers in-calf, 7 feeding drapes, 20 yearling heifers—making a total of 89 head of horned stock. The yearlings have hay and a small quantity of roots. The heifer calves are supplied as soon as they will eat, with ground oats, cotton- and oil-cake mixed, which are continued till they go out to grass the second year, after which no artificial food is given. Great losses have occurred from abortion, for which Mr. Batho can give no reason; but after seeing the nature of much of the pasture land, which is on a peaty soil, and bearing in mind the character of late seasons, it is probable that grasses affected by fungoid diseases, and especially *Ergot*, may have caused the evil. Very rarely are the services of the veterinary surgeon required, home treatment being preferred; and with the exception of slinking, the stock have been healthy. All liquid manure from the sheds is conveyed to adjoining grass land by pipes, and is considered to do much good.

The dairy is provided with a warm chamber, in which the cheeses are placed in winter for two days when newly made, which helps to ripen them. The cheeses, after being pressed, are carefully bound with calico, and tissue-paper on the top. The cheese-room is warmed by pipes and hot air. The whey, from which cream is skimmed, comes from a tank in the cheese-room into a vat by the piggeries. The latter comprise covered and open pens. Over the former is a granary, and at one end a drying floor for damp grain, made of perforated iron, the fire being placed in the stye under. In the centre of the range is a store-room for meal, &c., in which the whey vat is placed. The feeding-shoots are of Staffordshire (Buckley Mountain) ware, and the troughs are sheltered by a pent-house. Pigs are largely kept during the cheese-making period. The bull calves are sold as soon as is practicable, making about 2*l.* each. The rearers are usually allowed to suck the cows for three weeks or a month, and then old milk is given cold, after being scalded and mixed with meal and spice. As soon as possible they are induced

to eat cake, kibbled oats, hay, and mangolds. In hot weather they have the shelter of the yards in the day, and lie out at night, so as to be protected as far as possible from flies. We saw on our second visit in May a capital lot of 19, all thriving, and many nearly weaned. These calves were much grown, and evidently thriving extremely well. Two were lost in the interval.

Fig. 2.—*Plan of Winston Farm Buildings.*



1. Calves' house.
2. Cows' ,,
3. Cutting-room.
4. Mill.
5. Dutch barn.
6. Bay.
6A. Barn.
7. Stable.
8. Waggons.
9. Loose-box.
10. Hack-stable.
11. Young stock.
12. Gig.
13. Harness.
14. Box.
15. Bulls' box.
16. Implements.
17. Carts.
18. Parlour.
19. Pantry.
20. Offices.
21. Sitting-room.
22. Kitchen.
23. Vessels.
24. Press-room.
25. Bakery.
26. Coal.
27. Ashes.
28. Fowls.
29. Piggeries.

Possibly this may have arisen from chill when turned out, which we consider questionable policy. They were having a mixture of bean-meal, linseed-oil cake and bran. The herd of cows then numbered 55 head, 10 of which were still to calve.

They were mostly out at grass, but had only been in the pastures since May 12th, as Winston is not a forward country, and it is considered desirable to get a good bite. These cows have the run of 90 acres, shared, however, by the working horses, 7 in number, which are turned out at night. The cows are a very practical lot, mostly of shorthorn type, with here and there a dash of Ayrshire, all having well-formed udders and good milking qualities. They have from 3 to 4 lbs. a day of decorticated cotton-cake given at milking time. One red cow, six years old, a great favourite, gave 11,000 lbs. weight of milk last year, which is equal to 1100 gallons of milk; and calculating that a gallon of milk will produce a pound of cheese, we have 9 cwt. 3 qrs. 8 lbs. of cheese—a most extraordinary production. She was looking thin and out of sorts, having been much pulled down by twins in calving. These twins, when rubbed dry, weighed 142 lbs.* In the case of large milkers, when there is risk of fever, especially in hot weather, a part of the milk is drawn for a few days before calving, and the calf is left with the cow for three days, and care is exercised that the milk is never completely drained, as this checks the flow. Another precaution in hot weather is to keep the cows in during the day, and only turn them out at night. In the case of cows calving in winter or early spring, that is before they are turned out to grass, the calf is removed after having been licked. Most of the cows are reared, being by a shorthorn bull, selected from a good milking herd. We saw a yearling and a younger bull. The former was bred by Mr. J. Edwards, of Foxhill, and looked quite a likely sort to carry

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* As in the case of Mr. Nunnerley, we obtained from Mr. Batho the produce of his cows, on June 12, 1884.

42 Cows produced	1686 lbs. of milk.
Deduct	100 ,, given to 8 reared calves.
	1586 ,,

which, calculating 10 lbs. of milk to a gallon, equals 158 gallons and 6 lbs. of milk.
This yielded 210 lbs. of curd when salted.

Cheese weighed on June 26, 1884 ..	159 lbs.
Butter from all sources	8 ,,
Given an average per cow of	1 lb. $5\frac{1}{3}$ oz. per week.
The animals yielding this milk comprise	33 Adult cows.
	8 Heifers 3 years old.
	1 do. 2 years old.
	42
Remainder of stock consisting of—	
	5 heifers suckling calves.
	4 cows to calve.
	4 do. fattening.
	55

on and improve the herd. When Mr. Batho first occupied Winston, he lost in the first year 9 or 10 young animals from quarter-evil. He has found putting setons in the breast an entire preventive—an experience which we found generally confirmed. Mr. Batho told us that 60 gallons of milk in the autumn would make 77 lbs. of cheese, because milk is then at its richest, and will yield 20 per cent. more produce, either as butter or cheese, than during the first flush of grass in spring and early summer; but for the whole season he considered a gallon of milk for a pound of cheese was very near the mark. As regards cheese-making, Mrs. Batho, whom we should judge to be a proficient in the art, described the work as very hard; and this not so much physically as mentally, the responsibility of the dairy-maid is so great. It is not pleasant, she observed, when things do not go right. Judging from our observation, we should think this a very exceptional case at Winston. The yearling heifers which we saw in the fold-yard at our first visit, we found out at grass, with no extra food, looking in very good state, and a useful lot, to be served in July, so as to calve down at two years old.

The sheep stock comprise a flock of a hundred Shropshire ewes. Part of the lambs are sold fat in the summer. The whole are winter-grazed on pasture land, having a few roots supplied. Lambs are not shorn, as they make bigger prices when sold in spring. Ewe lambs are not put to the ram. Winston is probably too cold and backward a country for such a practice to be successful, and natural food is almost entirely relied on in the summer.

The stock at our visits in January and May were as follows:—

CATTLE.

January.		*May.*	
50	Cows.	51	Cows.
7	Feeding drapes.	4	Do. barren and feeding.
10	2-year old Heifers.	19	Yearling Heifers.
20	Yearling Heifers.	19	Weaning calves.
2	Bulls.	2	Bulls.
89		95	

SHEEP.

100	Ewes.	94	Ewes.
44	Ewe hoggs.	148	Lambs.
42	Wethers.	44	Ewe hoggs.
3	Rams.		
189		286	

PIGS.

56

HORSES.

January.	*May.*
4 Waggon Horses.	6 Waggon Horses (2 years).
2 „ Colts broken.	1 Cob Pony.
1 Cob Pony.	1 Hack.
1 Nag	
8	8

The arable land is chiefly worked on a four-course shift, which is, however, not rigidly adhered to. Roots are usually all carted off, in order to supply the requirements of a heavy stock of cattle, although the land is quite suitable for feeding on with sheep, and the cost of hauling both roots off, and extra manure back to some of the more distant fields must be a serious expense. It is quite certain that at least one-third of the crop, which has been produced at such a heavy cost, might with advantage be consumed on the ground by sheep. The swedes, from seed obtained from a grower in Somersetshire, were regular and very heavy. The average yield of cereal crops as given us is: Black Oats, 50 to 80 bushels (the latter return being from land recently broken up); Wheat, 35 bushels of 60 lbs.; Barley, 40 to 46 bushels of 56 lbs. These are large returns, and prove the condition and quality of the soil, especially when it is understood that the outlay in purchased foods and manures is under 18*s*. an acre.

To descend to particulars:—We found the clovers and seeds generally a good plant. Those for hay promising a fair yield, especially if soon favoured with rain. In a piece of 12 acres were two-year-old seeds, in which were the ewes and singles, a capital lot. This field had been dressed with 4 cwt. of mineral phosphate and 50 lbs. of nitrate of soda. As the land is rather strong, and not very near the buildings, it is under consideration not to plough this again, in which case, renovating-seeds would be applied, and there is every prospect of a good sward being established. Another field of 10 acres seeds, grazed by ewes and double lambs, without extra food; a good plant. A large field which was laid for hay after having been heavily grazed in the spring, followed by a dressing of 2 cwt. per acre of Liebig's manure, was promising and produced a heavy crop. All the grass seeds were supplied by Messrs. Carter and Co.

A field by the house which was formerly a rough and sour pasture, broken up by permission three years ago, and sown with black oats, yielded very heavy crops. As at present arranged, it is to be relaid after a course of crops, but considering the light nature of the soil, which is unsuitable for grass, and the proximity to the buildings, we expressed a strong opinion that it would be much better to keep down instead the 12-acre piece of two-year-old seeds, as proposed.

This field was partly in wheat, planted on the Lois Weedon system, *i.e.* 3 rows, 8 inches apart, and an equal interval, which allows of thorough cultivation. The plants were vigorous and promising. In July this crop was extremely luxuriant, and if it stands and does not blight—contingencies entirely depending on weather—there must be a very grand produce. The rest of the field was in mangolds and potatoes; it had been manured, and dressed with from 2 to 5 cwt. of phosphates and 1 cwt. of nitrate of soda. Both crops were excellent.

Close to the buildings were two fields, about 22 acres in extent, being prepared for, and partly sown with, roots. In both cases the corn stubbles were steam cultivated in the autumn and spring, then well worked by horse-power, ridged, and manured with 12 tons per acre of farmyard-manure, and 5 cwt. of Vicker's nitro-phosphate—a manure costing 4*l.* a ton. The land was clean and well worked. The favourable weather at the end of June and first week of July, when this district was visited by refreshing thunder-rains, had given these roots a splendid start, and we found them more than ready for singling, and well established.

The barley and wheat-fields, which were not looking well on our second visit, had greatly improved in July, and both promised very full crops. The wheat, which had suffered from late frosts, had been dressed with 1 cwt. per acre of nitrate of soda.

The barley and oats, beyond the canal, were splendid crops. Indeed the whole of the corn only required fine weather to ensure satisfactory results.

The great feature of management at Winston to which we call particular attention, is the treatment of the grass-land, of which a hundred acres rest on pure peat: this is not naturally by any means rich, and is liable to become covered in a short time with ant-hills and Tussac grass. This was the condition of things when Mr. Batho commenced his tenancy in 1877; and a large outlay in what is locally known as bogging and burning (*i.e.* digging out the Tussac grass, &c., burning the same, and spreading the ashes), and in the seed of Timothy grass to cover the bare spaces, has been incurred each year, until, at the present time, the land is comparatively clear of these pests. The average cost of such work is 30*s.* an acre, and requires repetition every six or seven years. The cost of labour is materially increased in consequence. But Mr. Batho stated his belief that the benefit derived from the ashes repaid the whole cost. The whole of this peat land is capable of subsoil irrigation by the damming up of a stream which runs through and round the fields, and which, by means of flood-gates or sluices, can be arrested at different points of its course. The land is drained at intervals of 30 yards, the outfalls being into this stream. The drains become

the media by which the water is conducted wherever the level allows, and so perfect is their action, and so porous the peat, that after the water has been held up for a short time it can be found anywhere within this limit practically at the same level as it stands in the ditch. This is a most valuable arrangement, ensuring a supply of moisture to the roots of the grass and increasing the growth, especially in dry hot seasons, and is preferable to surface irrigation, which would render the surface spongy, and require also removal of the stock when the water was being applied. Although this is the first really dry spring since Mr. Batho's tenancy, he considers that irrigation adds largely to his resources of summer food; and, curious to relate, his predecessor never availed himself of irrigation, and would not hear of the water being dammed up. The fresh appearance of these meadows in July, and the abundance of grass notwithstanding the heavy stock, was evidence of the great value of this irrigation. The water is applied first on May 12th and the dams are shifted about throughout the summer. Bones have been tried repeatedly on the peat, but do no good whatever. We were pointed out a portion of the cow pasture where five years since 8 cwt. of bone-meal was applied per acre; no effect was visible. Mr. Batho finds 4 or 5 cwt. of a highly soluble mineral phosphate most efficacious, but even this fails to produce clover. The worst field of the lot, 21½ acres, was in meadow this year. It was bogged and burnt during the winter—indeed the work was proceeding at our first visit—and in the spring dressed with 3 cwt. mineral phosphate and ¾ cwt. of nitrate of soda. A vast mass of tree-roots, mainly fir, have been stubbed out, and it is evident that this and probably most of the low land was at one time in forest, and the present herbage is nothing more than the wood pasture improved by cultivation. The drainage was done 21 years since, with Government money, pipes and collars being used. Recently these have been dragged out by the landlord, and were in many cases blocked up with Red Rag (Peroxide of Iron), which is usually abundant in peaty soils. This opportune work will greatly increase efficiency both for drainage and irrigation purposes. We were particularly struck with the good management of this grass-land, which was covered with good herbage and evenly grazed, whereas, if neglected and starved, it would rapidly degenerate; and we were surprised to learn that it is perfectly safe for sheep at all times of the year. The mowing ground comprises 25 acres of meadow and 12 acres of clover, as nearly as can be arranged.

Labour is economically managed, and a total of 330*l.* a year,

or 23*s.* per acre, appears extremely reasonable for a dairy farm; but it must be remembered that Mr. Batho is a worker himself, and is ably seconded by one of his sons, whilst Mrs. Batho and a daughter do their part indoors. The ordinary staff comprises two labourers at 14*s.* a week wages, with food on threshing days, and two waggoners. One cowman and a lad are hired to live in the house. Their joint wages amount to 52*l.* 10*s.*, and the girl's wages and extra outlay makes up the total money payments to 181*l.* 16*s.* 11*d.*

	£	s.	d.
Money payments for labour	181	16	11
Food for 4 men and 3 women	125	0	0
Extra Food in Harvest, &c.	25	5	0
	£330	1	11

Mr. Batho keeps accurate accounts as regards income and outlay, but has not hitherto made any valuation of stock at the beginning and end of the financial year; but assuming that the value remains pretty constant, we can assure our readers that the result of Mr. Batho's highly practical and intelligent management was not unsuccessful in that particular which the Society very justly considers of leading importance.* Considering the moderate outlay on foods and manures purchased, viz., under 250*l.*, a gross return of nearly 8*l.* an acre for dairy produce, stock and corn sold, is a remarkable result, which we can vouch for as having been realised in 1883.

It is not easy to institute a comparison between the Dairy Returns at Dearnford Hall and Winston. Assuming the figures below to represent, as we believe to be the fact, the produce of 50 cows, and that the whey is worth 50*s.* a cow, as was proved in the other case, and that 40*l.* is charged as the value of the rearing calves at birth, we have,—

	£	s.	d.
Cheese and butter sold and in stock ..	786	15	4
Calves sold and reared	141	14	0
Value of whey from 50 cows at 2*l.* 10*s.* ..	125	0	0
	£1053	9	4

This gives an average of 21*l.* 1*s.* 4*d.* as the produce per cow at Winston against 25*l.* 7*s.* 2*d.* for the same year at Dearnford Hall. And it must be remembered that we are assuming a very

* General management with a view to profit.

high value for the whey, bearing in mind the great difference in the food of the animals; for whilst in one case the outlay for purchased food and manure is under 18*s.* an acre, in the other it reaches the extraordinary total of 3*l.* 9*s.* an acre, by which a much heavier stock is kept per acre of land, and the produce is undoubtedly richer. Both are very largely above the average, and such practice may well be carefully considered by dairy-farmers in detail, and by the farming community in general, as indicating lines in which British Agriculture may hope to face the future, viz., by increasing the quantity of grass-land, and keeping more breeding and rearing stock.

Class I.—Highly Commended.

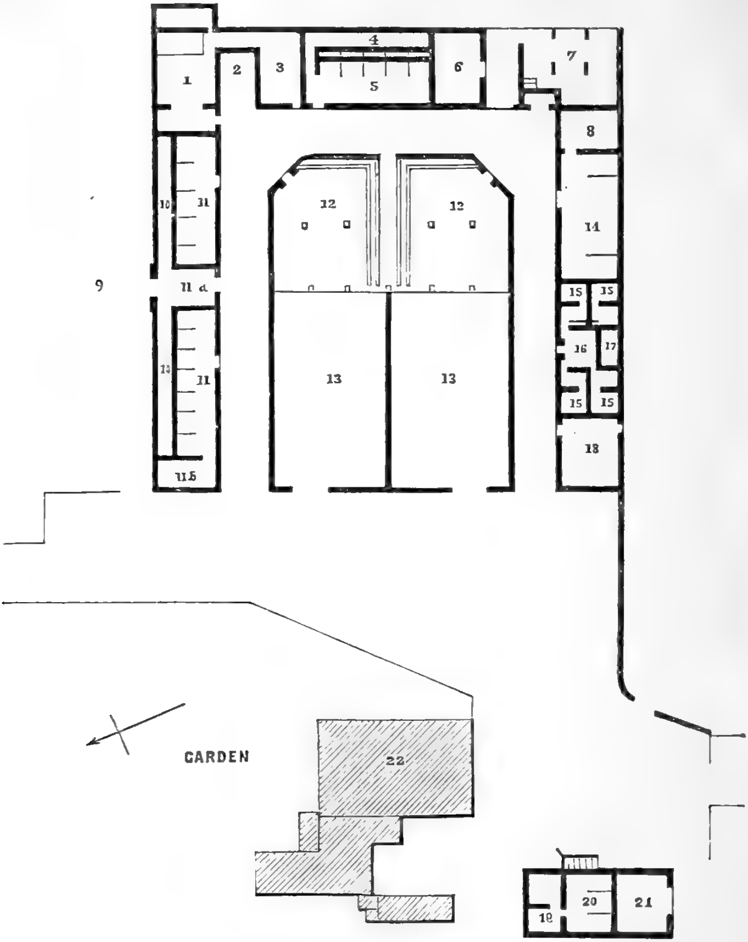
Mr. Charles Holme, Burley Fields and Hill Farms, Stafford.

	A.	R.	P.
Grass	252	1	14
Arable	162	1	8
Total	414	2	22

This farm is held on yearly tenure under Lord Stafford. Much of the land is a strong tenacious clay. The grass-land is mostly of good quality, suitable for dairy purposes, and much of the produce is sent to Stafford, one mile distant, where it is retailed by Mr. Holme. There are two sets of buildings, as nine years ago the occupation was increased by the addition of another farm. Two years since the buildings of the latter were entirely destroyed by fire, and were rebuilt principally on Mr. Holme's designs. Both are so well arranged that we reproduce them (Figs. 3 and 4, pp. 538 and 543).

Special attention should be directed to the excellent accommodation for young stock in the centre of the square (Fig. 3); the covered and open spaces allow of shelter and exercise, and the feeding passage down the centre of the covered part is economical of food and labour. The cowhouses, which are roomy and well arranged in connection with the food-supply, accommodate 36 animals, besides two calf-houses, bull's-house, &c. At the north-east corner of the building are the mixing-house, turnip store, and engine house, with hayloft over; and outside, but communicating, an open court for the reception and preservation of grains, which are largely used. The court is divisible by movable wooden partitions into three compart-

Fig. 3.—*Plan of Burley Fields Homestead.*



1. Mixing-room.	11B. Calf-house.
2. Turnip-house.	12. Covered yard.
3. Engine-house.	13. Open yard.
4. Feeding passage.	14. Stable.
5. Cow-house.	15. Pigs.
6. Bulls'-box.	16. Yard.
7. Cart shed.	17. Fowls.
8. Loose-box.	18. Cattle shed.
9. Rick-yard.	19. Harness.
10. Feeding passage.	20. Hackney-stable
11. Cow-house.	21. Gig-house.
11A. Fodder-house.	22. House.

ments, each holding 2000 bushels. The insides of the walls are cemented; the grains are carefully packed, and covered with two inches of cowdung collected from the pastures. Grains thus stored keep well and can be laid in during summer, when they are cheap. The court is, in fact, a species of silo for grains, and answers admirably. As regards the house, the dairy and kitchen are very inadequate for the requirements of a large farm; and both here and at the outlying buildings Dutch barns for the preservation of both hay and corn would be most valuable additions. The cows are carefully selected for milking qualities, and principally bred on the farm, with occasional purchases to maintain the necessary supply of milk for sale, which averages about 60 gallons a day. The additional produce is made into butter for the market and a little cheese for the house. The cows are of Shorthorn character, a pedigree bull from a good milking dam being used. In winter the cows are tied up in the shippon, but go out every day, weather permitting, for exercise. The calves are removed at birth, have new milk for three or four weeks, then old milk, warmed up, with calf-meal previously scalded. As soon as possible they are taught to eat a little hay, dust-cake, &c.; old milk and calf-food are given for two or three months. Mrs. Holme, who attends to the calves and poultry, told us that after long experience and serious losses, she believes she can now cure the scour, which she is convinced arises from the new milk being too rich for the calf's digestion. The food is at once changed, a dose of castor oil and laudanum is given to allay irritation; boiled skim-milk and sago, nearly cold, are substituted for the new milk; and if this food is too rich, then boiled sago alone, also given cold. The second day, and until the diarrhœa is stopped, one or two table-spoonfuls of the following mixture, viz. 4 ozs. prepared chalk, 1 oz. grains of paradise, 2 ozs. cummin seed, 2 ozs. aniseed, well mixed in a pint of starch gruel, to which may be added 20 drops of laudanum. The calves appeared healthy and thriving. In winter the cows live entirely on pulped, chopped, and steamed food, except that twice a day a small quantity of long hay is supplied for the object of encouraging rumination. The arrangements for the preparation of food are good. The power is supplied by a vertical engine and boiler, the waste steam being utilised for steaming chaff and pigs'-food. The cows have pulped food so steamed twice a day, to which grains and occasionally meal are added, and 2 lbs. a day of mixed cotton and linseed cake at three o'clock. Roots are liberally used, 84 lbs. to 112 lbs. a day. The swedes of 1883 were a splendid sample, and Mr. Holme stated they were proved by measurement to be over 30 tons per acre. The

hay, old and new, of which there was at our first visit a large stock, appeared well got and of good quality. At our second visit we found the cows out at grass, having 2 lbs. of mixed cake. Mr. Holme considers that in ordinary seasons 3 cows require 5 acres for pasture. The average quantity of stock kept will be seen from the inventories taken January 1, 1883 and 1884:—

CATTLE.

1883.		1884.	
26	Cows in-calf and milk.	26	Cows in-calf and milk.
5	Heifers in-calf.	10	Heifers in-calf.
5	Barren cows.	6	2-year old do.
17	Yearling heifers.	14	Barren heifers.
6	Yearling bulls.	22	Yearling heifers.
10	Young calves.	8	Young calves.
24	Calves.	4	Bullocks.
2	Feeding beasts.	3	Yearling bulls.
3	Bull stirks.	2	Bull stirks.
1	Bull.	1	Bull.
		4	Feeding beasts.
99		100	

SHEEP.

20	Shropshire ewes in lamb.	12	Shropshire ewes in lamb.
80	Cheviot ,, ,,	91	Cheviots ,, ,,
12	Horned ,, ,,	14	Horned ,, ,,
6	Rams	34	Yearling cross-bred sheep.
30	Yearling ewes.	6	Rams.
		30	Feeding sheep.
148		187	

HORSES.

1883.		1884.	
17	Horses.	10	Cart horses.
		1	Brood mare and foal.
		3	Colts.
		2	Milk ponies.
		1	Bay mare pony.
		1	Gelding pony.
17		18	

Mrs. Holme is a capital manager of poultry; about 120 head of these useful accessories are kept, and the average produce is as follows:—

	£	s.	d.
14,600 Eggs, at 14 a shilling	52	0	0
40 Couple of fowls sold at 4*s.* 6*d.* ..	9	0	0
10 „ of old do. 4*s.*	2	0	0
18 Geese sold	7	4	0
	£70	4	0

Mr. Holme carries out the details of the milk business, delivering to the customers direct—a business which requires close supervision. The men who deliver are supplied with books, in which they enter the quantities supplied in different columns for credit and cash. These books are carefully tested by the quantity sold, the cash brought in, and the quantity of milk returned. Mr. Holme or his foreman collects accounts weekly. Men are encouraged by a gratuity when they get new customers. The churns, which are cleverly hung in front of the axles of the carts, can be locked. The milk-carts, which are well adapted for their purpose, are a joint production of Mr. Holme and the Village Blacksmith. The seat is placed behind, by an iron support from the backs of the shafts; the whole is well balanced, and passengers are impossible. Price of the cart, 15*l.* No refrigerator is employed, but the milk is cooled in summer by running water.

On our second visit, in May, the stock comprised—

Cattle.	Sheep.
46 Cows and heifers in-calf and milk.	185 Ewes and gimmers.
30 Barren heifers and bullocks for grazing.	225 Lambs.
30 Rearing calves.	6 Rams.
15 Feeding beasts.	
4 Bulls.	
125	416

Horses.

10 Waggon horses.
5 Hacks.
1 Brood cart mare and foal.
3 Colts.

20

The cropping was as follows:—

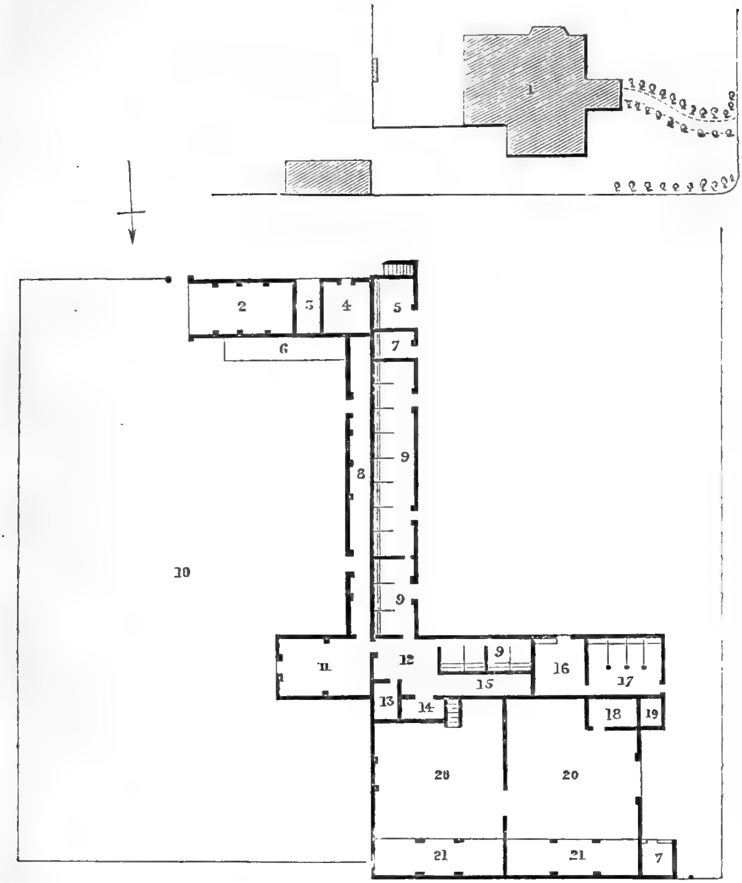
	A.	R.	P.		A.	R.	P.
Meadow for mowing ..	40	3	14				
Pasture	211	2	0				
				Grass	252	1	14
Wheat	54	3	18				
Oats	31	1	15				
Barley	7	2	22				
Beans	11	1	4				
Peas	10	3	0				
Seeds	23	3	3				
Turnips	22	2	26				
					162	1	8
					414	2	22

At this stage of my narrative I introduce a Plan of the Hill Farm buildings (Fig. 4, p. 543), which are extremely well arranged. The farm-house with a small quantity of grass-land is sub-let to a friend of Mr. Holme's. On our first visit a red cow, belonging to this gentleman, was pointed out to us grazing in the field as a wonderful butter-cow, and we were so much impressed with the dairy character of this animal, and with the record given of her produce, that we desired more accurate details. Mr. Holme vouches for the accuracy of the following information:—"This cow, which calved in October last, for the first ten weeks after calving averaged 15 lbs. of butter per week, the next ten weeks, 13 lbs. a week, and at the present time (July 18) (between eight and nine months after calving) is giving 10 lbs. per week;" and Mr. Holme adds, "these are positive facts, and the owner is prepared to make a wager of 50*l.* that, with plenty of corn, she would produce 20 lbs. per week for the first ten weeks after calving."

The buildings for food preparation are similar, but more perfect, than those at the home-farm, and comprise a roomy turnip-house, mixing-room, steam-chamber, engine-house, with granary and hay-lofts over; cow-houses, with feeding-gangways for 30 cows, the standings being separated by slabs of Welsh slate, costing 8*s.* each, very strong and durable. Two open yards for young cattle close to the food-stores, and provided with good shelter-sheds, stable boxes, cattle-shed with a lean-to, used as a lambing-house; bailiff's house, smith's shop, &c.

This portion of the holding has been occupied nine years, and great improvements have been made to fences, roads, and returning to grass some 40 acres of the least desirable tillage-land; the usual practice being to clean the land by a summer

Fig. 4.—*Plan of Hill Farm Homestead.*



1. House.
2. Cart shed.
3. Gig-house.
4. Hackney-stable.
5. Calf-house.
6. Shed.
7. Bulls' box.
8. Feeding passage.
9, 9. Cow-house.
10. Rick-yard.
11. Turnip-house.
12. Mixing-house.
13. Steam-house.
14. Engine.
15. Feeding passage.
16. Loose box.
17. Stables.
18. Tackle-room.
19. Goose-house.
20. Yard.
21. Open shed.

fallow, to manure it and sow wheat, in which the following seeds are sown:—10 lbs. cocksfoot, 10 lbs. Timothy, 5 lbs. meadow fescue, 1 peck of perennial rye-grass, 5 lbs. Dutch clover, 4 lbs. cow-grass, 2 lbs. perennial red clover, 4 lbs. alsike, 2 lbs. trefoil, and 2 lbs. rib-grass. The seeds were obtained from F. Dixon and Co., Chester. In the next spring 10 cwt. of ¼-inch bones were applied. The young layers are not mown, but grazed with light-mouthed sheep and young cattle. The flourishing appearance of the comparatively young grass (five or six years' growth), its rich colour and well-knit sward, evidenced the success of the system. We were shown one field in which a portion was not clean when laid, and though this was dressed twice with bones, and the rest only once, it is not half so good, justifying Mr. Holme's dictum, that land must be clean before laying down. All land laid down by the tenant remains as arable, and is either paid for or ploughed out. Another field adjoining that last described, which had been laid four years, was so bad at the time of entry, that Mr. Holme had the option of breaking, but wisely preferred improvement by consuming cake with sheep. It has now an excellent face, is full of herbage—on which sheep thrive better than on the old grass—and is worth twice as much rent as the strong arable land. Mr. Holme states that in early days when the farm required help, as much as 1000 tons of manure had been purchased annually. Nearly three miles of farm-roads had been made by the tenant with clinkers and stones from the land. The Hill Farm runs up to and surrounds the elevated mound, on which are the remains of Stafford Castle, a ruin dating from the twelfth century, some portions of which are still well preserved. Below the Castle are some irrigated meadows, useful both for early food and hay. The land being so strong, is not well suited for sheep, and in 1879 a large proportion were rotted. Cheviot ewes are bought in crossed with Long Wool rams, and the produce fed out. This spring a heavy loss of lambs occurred, attributed to over-feeding, causing curd in the stomach. The appearance of most of the grass-land was eminently satisfactory. The crops, on the whole, were excellent, but some of the tillage-land costs too much labour to pay; and it is most desirable in the interests of landlord and tenant that such fields should be laid down as soon as practicable. We must notice the excellent take of young seeds. One field laid for hay was extraordinarily bulky. The usual mixture—4 lbs. red clover, 4 lbs. cow-grass, 2 lbs. each of alsike, white clover, and trefoil, and a bushel of rye-grass,—was drilled in wheat, and this crop was dressed this spring with 6 cwt. of soot per acre. The other seeds which had been grazed were also excellent, and with rain would doubtless yield heavy crops. Wheat,

which was chiefly on strong land, had not maintained its early promise, and was not so good as we expected, rather spindly, and had evidently been checked by late frosts. I may here notice that in early days marl was very freely used, as is evidenced by the fact of a marl-pit existing in nearly every field. This was when wheat paid the rent. The land is naturally much too strong to be improved by being made stronger. Mr. Holme has liberty as to growth and sale, but sticks pretty closely to a four-course rotation. The strong land, except when fallowed, is kept in butts of 8 feet wide, which allows of work with the minimum of treading, and ensures that water shall not lie on the surface. Land is never cross-ploughed, which would be ruinous. So retentive is the surface that under-drainage is of very little use, and the whole secret of success is in the narrow lands allowing of the rapid escape of water. Winter-ploughing is done with four powerful horses in line. Wheat is always sown broadcast, red varieties being preferred. Manure made on the farm is chiefly applied to fallows for wheat. The land intended for roots was at our second visit partly sown, and partly being worked. This was one of the stronger fields, and the amount of work which had been expended in ploughing, scuffling several times with implements requiring five strong horses to move them, harrowing, &c., would make the roots costly, however big the crop. This field was perfectly clean ; and after rain, necessary to reduce the cast-iron-like clods, it would be ridged, manured heavily, and 6 cwt. of dissolved bones applied. Digging-ploughs and Staffordshire harrows are valuable implements for such land, and powerful horses are absolutely necessary. The oats were the most promising cereals. The great drawback to Mr. Holme's success is the heavy and unprofitable outlay on the stronger portions of the arable land. There is everywhere evidence of excellent management. The labour is well looked after, though of course on such a farm it mounts up. It comprises 2 waggoners and 2 boys. The men have 16*s*. a week, house, and garden, coals carted, and a quart of small beer daily, and more in harvest. The beer costs 6*d*. a gallon. In harvest about 50*s*. extra money is given. There are four day-labourers, who have 15*s*. a week and cottage, rent free, and beer as above, and 1 foreman, Robert Silcock, recommended strongly by Mr. Holme. Women are employed in stone-picking and clod-knocking. The latter important work is usually done by contract at 4*d*. an acre. The ordinary wages of women are 1*s*. a day, from 8 to 5. Two cow-men and 2 lads are kept, who deliver milk, clean their horses, and mix food for the cattle. The labourer and foreman help to milk, 6 cows being assigned to each man.

Class I.—Highly Commended.

Mr. John Mellings, The Pools, Bromfield, near Ludlow.

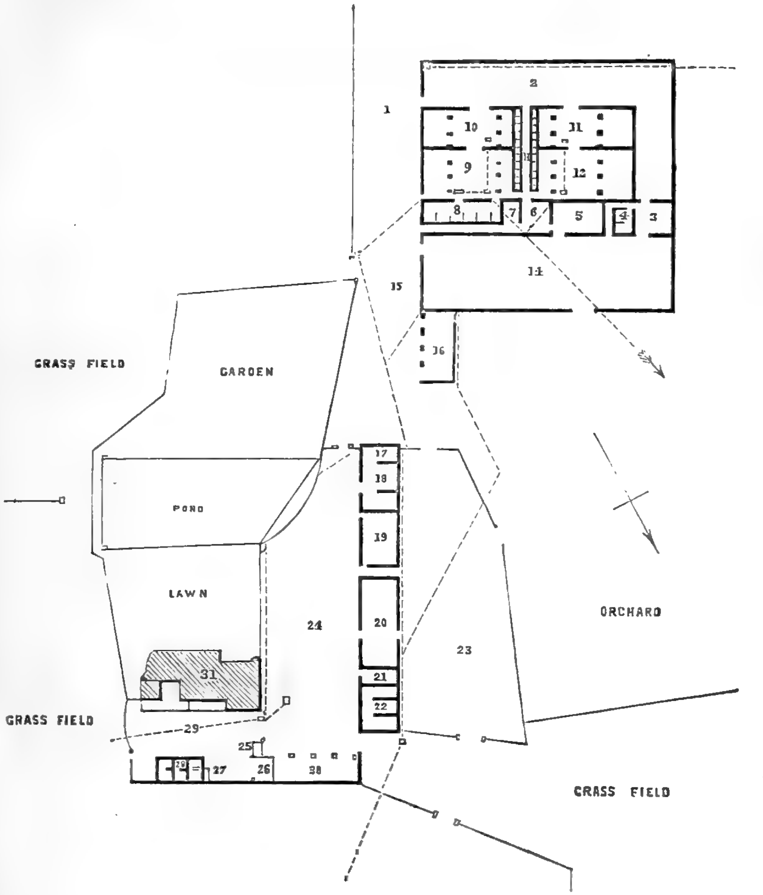
	A.	R.	P.
Grass	181	3	6
Arable	71	3	36
Total	253	3	2

This farm, principally strong land on the Old Red Sandstone, is occupied on yearly tenure from Lord Windsor, the present tenant having succeeded his father (who resides with his son) a few years since. In the spring of 1882 important additions were made to the homestead, fitting it for modern requirements. All leading of materials for this work, as well as for metalling a road from the highway to the house, and filling up broken ground in front of the new buildings, was done by the tenant, whose teams must have been severely taxed to do this extra work, and the ordinary work of the farm. So excellent are the new sheds and fold-yards that I think a ground plan showing their nature and position on rather higher land than the rest of the buildings, will prove interesting.

The features of the new buildings are the deep shelter sheds and open yards facing south, with a feeding gangway and mangers for each yard, roofed over so that the animals whilst eating, as well as the food, are protected from the weather. There is also a range of buildings on the north side, comprising byres for twelve cattle; hay and root house for pulping, &c.; turnip house, bull house, &c.; a small stackyard behind, and a cart-lodge and granary. It was a very wise arrangement to make the new buildings entirely separate from the old ones, and together ample accommodation and comfort are provided for the additional stock which the enterprise of the new tenant will maintain. The feeding arrangements, both for yards and byres, include a rack for straw and mangers, made of large glazed half-pipes, which are simple, efficient, and inexpensive. As fresh straw is of great value for the Hereford cows in winter, much of the threshing is done by an old horse gear and drum, and though this has an antiquated ring about it, we know from experience that it is a useful and economical practice where fresh straw is necessary. And that it is so here may be judged from the fact that the cows as a rule have nothing else during the winter; only such as are weakly get a few roots. The young animals have roots and cake, and the two-year-old bullocks are fed in summer also. The calves after running all

the summer with their dams, are fed with hay, swedes, and oat straw, pulped and chopped.

Fig. 5.—*Plan of Mr. Mellings's Farm-buildings.*



1. New road.
2. Ditto Round building.
3. Bull's yard.
4. Ditto House.
5. Turnip-house, loft over.
6. Pulping-room.
7. Hay boy.
8. Stalls.
9. }
10. } Open yards and sheds.
11. }
12. }
13. Feeding-shed.
14. Stack yard.
15. Open yard.
16. Waggon-shed, granary over.
17. Hay-barns.
18. Cart-stables.
19. Cow-house.
20. Barn.
21. Tool-house.
22. Hackney-stable.
23. Stack-yard.
24. Fold-yard.
25. Ferrets' crib.
26. Trap-house.
27. Dog crib.
28. Piggeries.
29. Open yard.
30. Open shed.
31. House.

Particulars of Live Stock, Jan. 1884.

Cattle ..	20	Cows and heifers.
	8	Bullocks rising 2 years old.
	6	Heifers do.
	2	Feeding cows.
	19	Calves coming 1 year old.
	2	Milking cows, Herefords, bought in.
	1	2-year-old bull.
Total ..	58	
Sheep ..	57	Ewes and lambs.
	59	Wether hoggs.
	36	Ewe hoggs.
	5	Rams.
Total ..	157	
Horses ..	4	Working horses.
	1	Do. lame.
	1	Hackney.
	2	2-year-old colts.
	1	Hackney yearling.
	1	Cart do.
Total ..	10	

The field of grass above the house, and through which the approach road lies, was originally in a very worthless condition. It was drained five years since, and dressed with 8 cwt. of bones per acre. This treatment has been evidently judicious, as the sward is now of a useful character and well grazed. The arable land, which is all of a strong nature, is limed every eight years at the rate of 3 tons per acre applied to seeds for wheat; lime is also occasionally used with soil as compost for grass. The best lime costs 11*s*. at the station, close to the farm; a dark variety is cheaper, at 7*s*. to 8*s*., from a kiln five miles distant. Mr. Mellings is a great advocate for lime, which he considers makes the land healthy for roots. The grass seeds used are a mixture of red and white clover, trefoil, alsike, and Italian rye-grass. Red clover cannot be grown so often as every fourth year. The swedes were an excellent crop, clean, and fully 20 tons per acre; they had been sown in drills 20 inches apart, and the plants had been set out from 8 to 9 inches. Manure is applied partly on clover leys for wheat, and partly on wheat stubble for roots. The swedes are ridged, and bone manure is

sown broadcast. Biddell's imperial white wheat, on clover-ley limed, was a full plant, and looked strong.

The fences throughout the farm were in a very improving condition; those between the tillage land are kept slashed; those against grass are allowed to grow up for shelter, and are laid when necessary. This work is done by contract, at 1*s.* 3*d.* for eight yards, including the cleaning out of the ditch. In 1881, forty-seven additional acres were taken. This land was in a bad state, and after fallowing it was laid to grass in 1882. The landlord gave seeds for eleven acres, the tenant did all the rest, as well as found all manure. Considering the nature of the land, and the short period since sowing, the appearance of this land was decidedly satisfactory. Much of the old grass-land is poor, and some requires draining.

An alteration of plan, and a late postal delivery, resulted in our visit on May 26th, being a day before we were expected, and we found the tenant hard at work with his men shearing, work which he executed with great skill; indeed the personal exertions of the tenant and his sisters form an element of economy that must not be overlooked. Commencing my remarks with the sheep stock, which require judicious handling on a farm where the land is nearly all strong, I may notice that the breeding animals appeared generally healthy, but that the lambs were rather dry in their coats, and it was evident that warm rain to freshen up the keep was much wanted. With the exception of slight showers, no weight of rain had visited the farm for a period of eight weeks. On our first visit we found fifty-seven useful healthy looking ewes on grass, with a little hay; fifty-nine wether hoggs, also on grass, with whole swedes, which, at our suggestion, were afterwards cut, with evident advantage, and these sheep then had half a pound of old oats per day; and thirty-six ewe hoggs, a very useful lot on fog, were getting a few white swedes. Mr. Mellings put the ram with his younger ewes for the first time last autumn, and is not likely to repeat the experiment; only two proved in lamb, and these cast their lambs. It is evident that his land, and the treatment he adopts, is not suited to such a forcing system. The conditions are not favourable to early development. Of the 57 stock ewes only two proved barren, and the remainder yielded 90 lambs, of which six died during the cold east winds of early May. The rest of the flock comprised 35 shearling ewes, 55 shearling wethers, which were hoped be to fed out during the summer with cake on grass; and 5 rams, making a total of 236 head. Considering the strong nature of the land, the management of the sheep appeared suitable and sensible, and we question if better results would be possible by any more forcing system.

The cattle were thriving and healthy looking, but not large or

greatly forced; they consisted of 16 cows in-calf, or with calves at foot; 6 two-year-old heifers not served, as the plan is to have the first calf at three years old; 8 useful two-year-old steers, rather small for their age; 9 yearling bullocks, and 10 yearling heifers—all useful. There were two barren cows to be fed, and two cows for the dairy, all which except the calves we saw at our first visit. The bull in service is a big two-year-old, "Patron 8th," bred by Messrs. Green, by "Dauphin 22nd" (6386), out of a "Prettymaid" cow; he is very lengthy, and wide in his fore-quarter, a superior beast, and calculated to improve the already useful type of cows. Mr. Mellings works his farm without a large outlay in purchased food, and, considering the nature of his land, it carries a fair quantity of stock; hence they are not large or forward for age, but they all look like paying the rent, and the rent is paid with a good margin, and this is the real test of good management. Pigs are not largely kept, as there is no dairy produce to consume. Two sows and six pigs complete the lot.

Taking into consideration the very heavy strain on the animal forces of the farm in 1882, and the nature of the seasons, the condition of the tillage land as to cleanliness was decidedly creditable. I may refer to the treatment of land intended for roots. The stubbles were manured in the autumn at the rate of from ten to twelve loads per acre. This was buried with a rather light furrow, *i.e.* about 5 inches deep, and crossed in spring from 2 to 3 inches below the autumn furrow, which ensures the manure being kept near the surface. Then the land was thoroughly worked by scuffling, harrowing, rolling, &c. The land was perfectly clean, and all was done that was possible to prepare it to grow a good crop, if the season allowed. It should be noted that the clover ley before the wheat crop was limed. The working of this field indicated judgment and system. The wheat, though looking pretty well, was not quite clean. We next visited a newly laid field, part of the additional land taken in 1881. Mr. Mellings is a cautious man, and before committing himself to large outlay in the way of artificial manures, he experiments on a small scale; so we were shown plots dressed with bones, which apparently had done no good, whereas lime and farmyard manure had both made a decided mark. And in a meadow intended for hay, 5 cwt. of an especially prepared mixture of Webbs' had helped the clovers, which were looking fresh and well. About thirty acres of old grass are mown annually, always the same ground, which is usually dressed with manure from Ludlow; but owing to heavy cartage-work alluded to, this important means of restoration had been rather neglected of late.

The labour comprises a waggoner, who gets 13*s.* a-week, a cottage rent free, half a gallon of cider daily all the year round,

and food in harvest, two hired lads in the house, having wages 12*l.* and 10*l.* respectively; and additional labour for fencing, harvesting, &c.

It will be interesting to contrast the outlay in labour for three years:—

	1882.		1883.		1884.	
		£ s. d.		£ s. d.		£ s. d.
Money Payments ..		96 3 10½	.. ..	101 15 10	.. ..	108 0 0
Miller's bill	6 2 0		5 12 5		8 17 5	
Smith's and Saddler's	12 1 8½		13 8 1		10 12 11	
Wheelright's	4 1 11		15 7 9		5 6 11	
Steam Threshing	7 12 0		4 11 0		8 0 6	
Miscellaneous	7 13 4		13 0 9		0 9 0	
		37 10 11½		52 0 0		33 6 9
		£133 14 10		£153 15 10		£141 6 9

If we take the average of the three years it gives 11*s.* 2*d.* an acre as the money payments for labour and tradesmen's bills, to which must be added the food of the lads in the house, cider, rent of cottage, &c., which we estimate at 65*l.*, which gives the total cost of labour 16*s.* 2*d.* an acre—a remarkably low figure.

The outlay in foods and manures was—

1883.	£ s. d.	1884.	£ s. d.
Feeding Stuffs	37 0 9	Feeding Stuffs	61 7 9
Manures	54 19 0	Manures	65 15 0
	£91 19 9		£127 2 9

As regards the yield of crops, the following particulars have been worked out from local measures supplied by Mr. Mellings:

1881.	1882.	1883.
Wheat, 34 bush. of 60 lbs.	27½ bush.	30½ bush.
Barley, 32 bush. of 56 lbs.	35½ bush.	33½ bush.
Oats, 40 bush. of 40 lbs.	80 bush.	Black Oats, 60 bush. White Oats, 50 bush.
Beans.	40 bush. of 60 lbs.	

It would have added very largely to the value of Mr. Mellings' experience if I could have contrasted his money results with those of others who pursue a more forcing and artificial system; but this I am precluded from doing for reasons which will be readily understood. All I can do is to point out the economy of outlay and to show that, considering the small amount expended, the returns are very satisfactory. The stock, crops, implements, and household effects make up a valuation of about 2300*l.* The gross receipts from sales in the year ending April 1883 were as follows:—

	£	s.	d.
Horses, &c.	44	0	0
Cattle, ditto	440	15	6
Sheep	255	7	0
Pigs	54	3	3
Grain	270	15	6
Wool	47	11	9
Butter	36	0	0
	£1148	13	0

This is a very different rate of gross produce from the Prize farm, but so also is the expenditure; and we are not sure that the net result is not quite as satisfactory. It may, I think, be taken for granted that Mr. Mellings works his farm with not more than one-half the capital employed by Mr. Nunnerley—a very important consideration. Both systems are right under their special circumstances; but great credit is due to the man who, by such careful and judicious management, shows how land which is not desirable, and which at the present time is much out of fashion, and which in less thrifty hands might soon get out of order, may be profitably worked with a comparatively small capital: for there is also little doubt that too many farmers at the present day are more likely to require instruction how to farm profitably with small means, than how to aim at the splendid results attained in the case of the first Prize Farm.

Class I.—Commended.

Mr. Henry Hardeman, Woofferton, near Ludlow.

Grass	115	acres.
Arable..	50	,,
	165	,,

Held on yearly agreement under trustees of the late — Foster, Esq., since 1876. The tenant is a hard-working, persevering, energetic man, ably backed up by an excellent wife, who manages the dairy with great skill. Ten cows are usually milked, and on our second visit we were shown a week's produce (80 lbs.) of beautiful butter. The milk in summer is kept in a cellar in zinc milk vats, which are much cheaper than lead, and equally serviceable. Even more important than the dairy is the successful rearing of calves, as to which Mrs. Hardeman has been most fortunate. She gives them new milk

only for a week, gradually reduced and replaced by skim-milk, meal, and a little spice. The milk is scalded, and given lukewarm. Between October and May, 45 calves were reared. Most of them were bought, averaging 35*s.* each. When I add that Mrs. Hardeman has seven young children, the eldest only twelve, and keeps everything going, it will be apparent that "her price is above rubies."

The farm is chiefly on gravel, and much of the grass is good, but it lies very wide, and certainly is not cheap. The buildings are badly arranged as to economy of labour, but are useful and roomy. The cow-houses at our second visit were carefully white-washed, and the woodwork was gas-tarred. The liquid manure from the yards is conveyed a great distance by iron pipes into a meadow, and any good it does is very inadequate to the cost of conveyance; but the pipes can be utilised for supplying water from a small brook, and thus the meadow can be partially irrigated, which is at times of material use. The outlay would have sufficed to cover over the yard from whence the liquid manure is supplied. A mixed herd of Herefords and milk-cows are kept, and the land is very heavily stocked. Thus at our first visit we found—

7	Hereford cows, some with registered pedigrees, fed on pulped swedes and chopped straw; they are tied up, with exercise daily for an hour or two.
14	milk-cows, for butter and rearing.
8	yearling Shorthorn steers, having pulped roots and chop, and long straw.
1	three-year-old Shorthorn bull.
12	calves, from 6 to 10 months old, from dairy cows.
4	pedigree Hereford calves.
13	rearing calves.
59	total.

The management of the Herefords is that which generally prevails throughout the district. The calves run with their dams, and consume all the produce.

At the time of our first visit the butter was sold by contract in London at 15*d.* a pound, Mr. Hardeman finding crates and paying carriage. It was estimated that the produce averaged 19*l.* per cow.

By butter	£12
„ skim-milk . . .	5
„ calf	2
	£19

Mr. Hardeman keeps an excellent flock of Shropshire sheep, and approves of breeding from ewe lambs, as the better keep, which is a necessary condition of success, increases size. Out of 30 ewe hoggs put to the ram last autumn, 20 had lambed at our second visit, 4 were barren, and the rest doubtful. We saw these youngsters, and they were decidedly promising, and appeared thriving. Such forcing treatment requires careful management and generous diet; but when soil and climate are suitable, this early development meets the requirements of the age, and we shall not be surprised to find this practice as well as the shearing of lambs extending. We found in January, 69 breeding ewes, and 40 ewe hoggs. These were on grass, having whole swedes and grass, with a little hay; 50 wether hoggs were on swedes, with a bushel of oats daily. These are not fed out, but are sold in June for grazing. Total head of sheep, 159.

The horse power is rather excessive for the area of arable land, but the land lies wide, and mares are bred from, and young horses sold.

5	draught horses, chiefly useful roomy mares.
2	cart colts, two-year-olds.
1	,, yearling.
2	nag colts, two-year-olds.
2	,, yearlings.
1	Welsh pony.
2	colts, rising three years.
1	thoroughbred stallion, "Actæon," aged.
16	

Pigs are an important feature of the farm stock. The middle breed sort are kept.

8	breeding sows.
2	fat pigs.
14	porkers.
17	stores.
41	

It will be seen from above that this farm is heavily stocked, but it must be explained that there is a common right attached to the farm on Hanway Common, which is useful as a run for the ewes after weaning. This year 42 acres of meadow, and 9 acres of clover after grazing, were laid for hay, and unless rain came soon after our inspection, the result must be a very light crop. The meadow land is extremely well managed. The same ground is mown each year, and manured in alternate years; a large quantity of sawdust manure (*i.e.* sawdust being the

material used for bedding horses) from London is used, which costs 5*s.* a ton, delivered at Woofferton. There are two orchards, and last year 370 apple-trees were planted, only 7 of which died. Farmyard-manure is applied round the trees, which were most promising.

Wheat stubbles are manured for swedes, which grow well. In addition to this manure, 5 cwt. of ground bones is applied at the time of sowing. At our first visit we saw a capital crop on the ground, the produce of 1883, very regular, and not over-estimated at 25 tons per acre. Mangolds are not much grown, as they do not yield well. Every eight years the land is limed, which partly accounts for the success attained. It is evident that with such a small quantity of tillage land, and the moderate outlay in purchased food, viz. 60*l.* in mixed cake, good crops must be grown to carry such a heavy stock. The young seeds were excellent, thick on the ground and full of clover. Wheat follows clover, and suffers from wireworm. Its average yield is 36 to 38 bushels of 60 lbs. Barley yields about the same. Oats are seldom grown.

We saw at our second visit one field of square-head wheat, after peas, a splendid promise. The pea-stubble was limed at the rate of 3 tons per acre. The roots recently sown and the barley were suffering from want of rain, and unless the district was soon favoured with considerable downfall, the prospects for the present year were not encouraging. Mr. Hardeman does not keep accounts. But his careful clean management deserves commendation, as he is a hard-working improving tenant, who has worked his way up, and gradually increased his stock, which is good all round.

Class I.—Commended.

Mr. R. L. Acton, of Brockton, Much Wenlock.

Grass	180 acres.
Arable	104 „
	284 acres.

The farm is held by the year on parole agreement from Jasper More, Esq., of Linley Hall. It comprises useful grass-land, partly irrigated, below the village, and higher land, principally arable, above; the latter is exposed and probably rises to 800 feet above the sea. The climate is backward, and wheat is not a dependable crop, owing to the late harvest. The soil varies from strong clay to useful gravel, resting on Ludlow shales; it is deficient in lime, a dressing of which every eight years—for wheat

3 tons per acre—has an excellent effect. It is hauled from the kiln about two miles distant, where it costs 7*s.* to 8*s.* a ton. No strict rotation is followed, and occasionally two corn crops are grown. The root crop of 1883 was good, and the land appeared fairly clean, considering seasons. At our second visit we found work much behind, owing to a severe attack of "pinkeye" in spring, and to extra roadwork in hauling materials for additional buildings which the landlord is erecting, and which, including a spacious covered yard, were much needed, and will add materially to the value of the farm. The success of the root crop would depend upon rainfall coming in time, but Mr. Acton was quite content with the weather, which suited his strong soils well. Here we saw the best field of winter beans in our travels, and as, at our first visit, we saw the pulse from a crop after barley stated to have yielded 7 quarters per acre; it would appear that this land is suitable for this usually uncertain crop. Barley on wheat stubble, the latter manured for, was clean and promising; the wheat was fair. This is essentially a stock farm, and the Hereford cattle are doubtless well suited to a high, exposed country. The herd comprises Herefords, with three Shorthorns as nurse cows—a fact specially noted by one of the Judges, and which we found in other cases. The cows and heifers in-calf, 27 head, were useful and mostly well descended. "King Dick," a four-year-old of Messrs. Green's breeding, was in service. The general practice here and elsewhere is to calve the cows in the spring, the nearer grass time the better. Until calving the cows live cheaply, on straw and a few swedes; and such are the feeding tendencies of the Herefords that they usually keep their flesh wonderfully. After the calf is born, and until the grass is ready, better food is given, and the cattle are turned out fresh into blooming pastures, where dam and produce have a fine time for the laying on of flesh. Gradually the cow dries as the calf ceases to require the milk. It is no wonder that, with such a system, the milking-powers of the cows are mediocre. The calves, always kept in fat condition, must lose their milking properties. We saw a capital lot of young animals, including 7 two-year-old bullocks, 4 yearlings, 10 bullock calves of 1883, 2 bull calves, and 11 heifer calves, all thriving and in first-rate condition. The bullocks were feeding in open yards, separated by a fence of rough rails secured to the posts by old horse-shoes. The elder lot were getting 100 lbs. daily of sliced roots, hay, and straw, and 10 lbs. of mixed cotton- and linseed-cake—costly food,—on which they were thriving. These animals had not been caked on grass. Rock-salt is liberally supplied. The calves of both sorts were a very smart lot; they had been weaned when the cows came up from grass, and were getting

2 lbs. of mixed cake and a small quantity of roots with hay and straw. They are always setoned as a prevention of quarter-ill, to which the farm is liable. With the Hereford bullock calves were two steers by a Hereford sire out of Shorthorn cows, both reared by a nurse-cow, and looking promising. Mr. Acton had reared 7 bull calves, 5 of which were gone previous to our visit. When weather is open, cows and heifers have to get their own living during the day-time, and with such scanty treatment they looked remarkably well. It must be remembered that the Hereford system is cheap as regards winter food and labour. For example, at Brockton, the annual cost of labour, including rent of cottage, food, &c., does not exceed 272*l.*—about 19*s.* an acre, made up as follows:—

	£	*s.*	*d.*
Waggoner, shepherd, and carman, 14*s.* a week each, cottage and garden, coal carted, &c. ..	124	4	0
Extra wages at harvest	3	0	0
1 labourer, 13*s.* a week, with cottage, &c. ..	38	16	0
1 boy, 10*s.* a week	26	0	0
1 man in house, 6*s.* 6*d.* a week, and food calculated at 9*s.* a week	40	0	0
Extra labour	40	0	0
	£272	0	0

Sheep-Stock.—Here again, as in the case of the herd, much judgment has been exercised; and the sheep, which have much of the Wadlow blood in their veins, have wide level frames on short legs:—

January.	*May.*
84 Ewes served.	50 Ewes and twins. 100 Lambs.
30 Ewe lambs do.	27 Ewes. 27 Single lambs.
20 Smaller ewe lambs.	10 Shearling ewes. 10 Lambs from do.
48 Feeding hoggs, and rams.	44 Shearling ewes, &c. 9 Rams.
182	277

The experiment of breeding from ewe lambs was tried last autumn for the first time, and the result appears to demonstrate that, in such a climate as Brockton, it is of doubtful advantage. Of 30 animals served, only 10 proved in lamb, and 1 died. It remains to be seen how these young matrons will compare with their less hard worked sisters next autumn. When we saw them in the winter, they were getting ½ lb. of cake and a moderate allowance of turnips and hay. If they had not been

served, it is probable the cake would have been saved, but, of course, this may pay in increased size and value of manure. The ewes were clearing up the haws of swedes, with hay and a run on grass, and did well. The lambs at our second visit were a capital lot, the doubles especially promising. We found them on seeds, without any additional food, but earlier in the spring they were well cared for. The seeds, which were manured in October, were of a good colour, but thin on the ground. Mr. Acton takes great pride in his horses, which are a capital lot; he does not breed much, but buys them young and works them on his hilly uplands till five years, and then sells them for town purposes. We saw at our first visit 6 horses, including a brood mare; afterwards we found 7 animals; they were of excellent type, with lots of bone, big barrels, short joints, and plenty of hair; a hunting mare) "Betsy Bee" by "Buckingham"), her foal, and a Hackney. A valuation made on January 1st, 1884, gives the following total:—

	£
Cattle	1212
Horses	460
Sheep	725
Pigs	37
	£2434

The outlay in cake and manure averages about 200*l.* a year. This does not include lime.

The management and character of the stock at Brockton are the features that deserve commendation.

Class 2.—First Prize.

Mr. Francis Hawkins, Sugwas Farm, near Hereford.

Arable	283 acres.
Pasture	250 ,,
Total	533 acres.

The landlord of this farm is Sir James Ingham. The tenancy dates from 1857. The arable land is a free working loam, on gravelly subsoil, which in some places runs into large stones, and on the browny spots has a decided tendency to burn. The grass-land, especially the meadows bordering the Wye, is of a fertile nature, on a stronger loam. The formation is the Old Red Sandstone.

The buildings comprise two large yards, facing south, with deep shelter sheds and gangways, forming a lean-to to the main

range of feeding houses, also machinery space, granaries, &c. An old barn has been cleverly converted into a capital feeding-house, and corn-chamber over. There are also two large Dutch barns, one erected by the landlord, the other by the tenant. The buildings are all spouted, but on our first visit the liquid manure from the yards, which are rather exposed, was wasted. We expressed our opinion that this might be utilised, and Mr. Hawkins, who has great mechanical tendencies, at once set to work and fitted up one of Hydes and Wigfall's small rotary pumps, to be worked by the engine, and so contrived as to answer a double purpose, viz. to draw water from a tank for the engine, or to drive the liquid manure by means of pipes and hydrants on to a grass field near the house. The field so treated looked extremely well, and will no doubt cut a much heavier crop than if it had not been so dressed, especially in such a dry season as this is. The whole cost of this addition, including the pipes, viz., the suction pipe, laid a distance of sixty-six yards, and the delivery pipe, which extends 290 yards, was as follows:—Pump and fittings, 10*l.* 18*s.*; $1\frac{1}{2}$ in. Piping, 19*l.*; fixing labour, 4*l.*; total, 33*l.* 18*s.* The machinery, which is driven by a 10-horse power portable engine, which is also used for steam-cultivating tackle, comprises a threshing-machine, a bone-mill (Savory's), a clover sheller, pair of French stones, pulper, and chaff-cutters, &c. In the winter the engine works every day. The arrangement of details is excellent.

This is essentially a grazing farm; and beyond three dairy cows for the use of the house, all the horned stock are bought in, and are principally Herefords, which are admirably adapted to the purpose. On our first visit in January, we saw in the yards a grand lot of 35 three-year-old bullocks, bought in October, having pulped swedes, chaff, equal parts of hay and straw, and 4 lbs. of linseed-cake. These animals appeared very quiet, and were evidently doing well. On our second visit we found 27 of these animals waiting for delivery, having been sold. They had done well, and looked like an average of 63 imperial stones, but, owing to a serious fall in prices, had not paid well. Indeed, we question if they would leave more than 6*s.* or 7*s.* a week—a return quite inadequate to the cost of food, which was increased in March to 8 lbs. a day, viz. 4 lbs. of ground corn and 4 lbs. of mixed cake. They had, however, done good service as manure-makers, part of their produce having been already utilised for the root crops, and the remainder was turned up in heaps in the yards, where it will remain till after harvest, and be carted on the stubbles.

Returning to our first inspection, we next saw two lots of grazing heifers, 45 in all, tied up, getting 4 lbs. of cake and 3 lbs. of meal, mixed with water, and thrown on the chopped food, &c.,

in the mangers; 3 dairy cows and a calf; 2 bulls, feeding; and 21 grand young bullocks, rising two years. These latter were in yards, but let out for two hours daily, their destination being to graze in the fertile pastures of the Wye, where we found them on our second visit, much grown, and thriving famously. In addition to excellent grazing, they were having 4 lbs. a day of decorticated cotton- and linseed-cake in equal proportions. From an estimate of value, we thought they had gained 6*l.* 10*s.* a head from the cost price in November, and allowing for the difference of food, they had done better than the older lot. Mr. Hawkins's usual practice is to buy Irish drape cows in the spring for summer grazing; but owing to the prevalence of foot-and-mouth disease, horned stock were not in their usual numbers on our second visit, the principal purchases having been 9 Shorthorn bullocks, coming two years old, which cost 16*l.* 5*s.* in April, and were a promising lot. In January the total number of horned stock was 107, whereas in May there were only 69 head, and in July these were further reduced to 48 head; but Mr. Hawkins was contemplating a large addition to his cattle stock, which the condition of the pastures then fully justified. The 107 animals were consuming about 2 tons of roots a day, about 42 lbs. average per head, which is not extravagant feeding. Mr. Hawkins likes quick returns, and therefore prefers buying his cattle in fresh condition, and passing a great number of animals through his hands during the year. The success of such a system depends upon judgment as to the kind of animal that will feed, and acuteness as to buying in the cheapest and selling in the dearest market. The returns must of course vary according to the relative value of stores and fat animals.

Sheep.—A heavy stock of Shropshires are bred on the farm. The numbers at our visits in January, May, and July were as follows:—

January.	*May.*	*July.*
148 Full grown ewes,—food, 2 oz. crushed oats, hay, chaff, and swedes.	260 Ewes } on grass and 350 Lambs } seeds.	283 Store ewes.
138 Young ewes, ¼ lb. oats, and swedes and hay chaff.	116 Ewe hoggs.	85 Draft ewes.
123 Gimmers shorn, 2 oz. crushed oats to be continued till February, roots, hay-chaff, and hay.	120 Wether do.	349 Lambs.
120 Wether lambs, } also shorn, 20 Ram lambs } 3 to 4 oz. linseed-cake, hay, chaff, twice a day.	20 Rams. 109 Barren ewes and small hoggs.	254 Feeding sheep. 2 Rams.
4 Rams.		
553	975	973

Considerable lameness was visible at our first visit, caused from proud flesh, which requires careful treatment, as it may otherwise seriously affect condition. From one-third to one-half of the root crop, according to circumstances, is consumed on the land. Iron hurdles, 6 feet long, and costing about 3*s*. each, are used, and are both durable and cheap. At our second visit the ewes and lambs, a very promising lot, were on grass. The 260 ewes produced over 400 lambs; but severe losses occurred during the cold weather in April from curd in the stomach, over 50 having succumbed to this serious disease, which was attributed to the cold weather and the richness of the food. The hoggs were on seeds, those intended for the butcher having a liberal allowance of cake. Here again, as in many other instances, the farmer prefers not to force his hoggs whilst on roots, but to finish them off on seeds, because the quantity of cake necessary for early maturity would make the land too rich for good barley, and the crop, especially in a moist season, would be lodged and spoilt, whereas the eating of cake on seeds always benefits the wheat crop. On a farm of this kind, where tillage predominates, the practice is no doubt justifiable. Mr. Hawkins clips his lambs at the end of June, because dipping is more efficacious, and the risk from maggots is reduced. Flies are very troublesome, owing to the number of trees in the pastures. The flock is found to pay better than cattle, and great care is exercised as to the selection of rams and the drafting of the ewes. The flock were remarkably uniform in size and type, and appeared thriving well.

Horses.—Considering the amount of heavy work effected by steam-power, of which more anon, we were surprised to find such a large force of horses (see p. 562); but the explanation is that, after working on the land for two to three years, the young horses at five or six years old are prepared for the market, and make large prices. This we can readily imagine, as they are an excellent stamp, big of bone and body, with good feet and plenty of hair, and just the animals for town work. Great attention is paid to the selection of sires. Thus we found seven most promising three-year-olds, by a grand sire, Mr. Woodbridge's "Great Britain," of Bampton, Oxon. These were broken, and ready for work.

The hours of work, which at times is heavy, are eight hours in winter and nine hours in summer, with a break at mid-day. The winter food comprises a mixture of ground oats, Indian corn, and beans, 10 lbs. a day, with chaff, and 12 lbs. of long clover hay.

The horses at the time of our second visit comprised—

11	working horses, 4 of which had foals sucking.
2	brood mares, one of which had foaled (not worked).
7	three-year-olds, broken in, and ready for light work.
2	,, unbroken.
4	two-year-olds.
3	yearlings.
1	entire cart colt, two-year-old.
1	two-year-old nag colt.
1	yearling ,,
1	hackney.
1	pony.
39	total, with the foals.

Pigs are bought in as stores, and are not bred on the farm.

As the merit of Mr. Hawkins's management is quite as apparent in the treatment of his land, both arable and grass, as in the skilful handling of his stock, it is incumbent to give some details of the fields.

The promise of our first visit was fully borne out at our second and more critical inspection on May 27th. The weather was, and had for some time been, hot and droughty, and here and there were indications that the gravelly loams at Sugways Farm would be much better for rain. Still no serious harm was then apparent, and the crops on the whole were most promising, indicating high condition of land, and proving that good farming was the rule, and that extra condition had not been supplied for a special occasion. I may add that on our last visit in July, notwithstanding the serious and long continued drought which extended to nearly the end of June, all the crops without exception were excellent, and indicated very large yields. Our inspection commenced with No. 568, 17½ acres, of which 7 acres nearest the buildings were in vetches after wheat, a most luxuriant crop, perfectly clean, dressed with 3 cwt. dissolved bones, to be mown for the horses, and followed by late turnips. The remainder of the field was being steam-cultivated for roots. Mr. Hawkins finds great advantage from this power, from the rapid and thorough way in which spring work can be performed. It has been used for twenty years, having been introduced by the father of the present tenant, and comprises a 10-horse power engine, Barford's roundabout tackle, Campain's self-moving anchors, and Fowler's cultivator. The windlass being coupled to the engine allows of one man working both, whilst two other men work the cultivator, and attend to the anchors and porters. The stubbles were horse-

ploughed in autumn, thrice cultivated by steam in spring, and well harrowed and rolled by horse-power. It was intended to apply manure on the flat, where not ploughed in, in autumn, and to plough, and drill the seed with dissolved bones and ashes. Part of the field was stony, and the cultivator brought up big stones 3 to 4 cwt. each—these we should imagine to be boulders from the sandstone, as the soil appears entirely of a drift nature. As the field was hilly, an extra lad was employed to manage additional porters, to prevent undue friction of the rope; on ordinarily level fields three hands suffice. The work was excellent, the soil quite clean, and with such depth and fineness of soil there was every prospect of a successful result, which was realised at our last visit, when we found a uniform growing crop carefully set out. This is done by contract, 9*s*. an acre being paid for two hoeings.

No. 562, 12 a. 2 r. Young seeds. This is also a light soil, full of stones. The mixture comprised 6 lbs. of red clover, 6 lbs. of white Dutch, 2 lbs. of suckling, 2 lbs. of alsike, and 4 lbs. of Timothy-grass, which is preferred to rye-grass, as less obtrusive, not so early, and as yielding very nutritious produce. Nothing could look better than this sward, considering that the field was closely grazed up to the end of March with sheep, having a mixture of oats and cake, about ½ lb. per head. It was also fed with lambs in the autumn. With suitable rainfall, this field could grow fully two tons per acre of first-rate quality; and bearing in mind how much food had been produced both in autumn and spring, the advantage of high condition is apparent. We saw a splendid lot of hay carried from this field, which was stocked in July with the wether and ram lambs, and though heavily stocked was full of keep.

No. 572, 18 a. 2 r. Chevalier barley, 10 pecks sown per acre, and seeds for grazing (no red clover sown) after swedes and turnips partly consumed on the land. The barley was strong, with full plant, and clean; would have been better for rain.

No. 574, 25 a. 2 r. For roots. Cultivation similar to that of No. 568, and like that field clean as a garden. This was most admirably worked and ready for sowing, when season and weather rendered it advisable. I trust to have made it quite clear that horse work in spring is confined to harrowing, rolling, and ploughing in the manure. These swedes, which were sown later than No. 568, were a regular plant, and nearly ready for singling, at our last visit in July.

No. 573, 17 a. 2 r. Old grass. Upland pasture, chiefly used for sheep, of which it carries a heavy stock liberally supplied with cake and corn. It has been recently dressed with a compost of soil, lime, and bones. The quality and produce were excellent, and it was evenly grazed.

Nos. 569 and 549. Both in barley, the latter field suffering from wireworm and requiring rain; otherwise the corn was forward and promising. Mr. Hawkins considers that, taking the higher land and stony brows into consideration, 40 bushels imperial is an average crop, which supposes much more on the best parts. Both these fields presented a most promising appearance at our last visit.

No. 546, 22 a. 2 r. Hunter's red chaff wheat on clover-ley, dressed with 3 tons of lime per acre, which improves the quality of the corn, strengthens the straw, and acts beneficially on the succeeding root crops. The ley had only one plough, and of seed, 2½ bushels per acre, was drilled in November. Part of the clover was seeded, but there was no perceptible difference in the crop, which was excellent throughout, and looked like 5 to 5½ quarters per acre. The wheat was eaten bare by sheep in the early part of April as a preventive of too great luxuriance.

No. 542, 15 a. 2 r. Winter oats on wheat stubble, 3½ bushels of seed per acre. This was also fed off by sheep, which probably accounts for its bunchy appearance. This field was not quite clean, and is intended to be worked by steam power in the autumn for roots next year. The inequalities alluded to had entirely disappeared in July, when the crop looked like yielding from 50 to 60 bushels per acre.

No. 541, 34 a. 2 r. Biddell's imperial wheat on clover, part seeded. Not limed. Part of this field is thin and weak, and the crop was there not so strong, but very good on the whole, and quite clean.

No. 545, 16 a. Mangolds on 10 acres, coming well. This land was deeply ploughed in autumn, burying 12 to 14 tons of dung per acre, and steam-worked this spring, then 5 cwt. of dissolved bones was broadcasted, the land raised into drills, and sown with 8 lbs. per acre of Carter's prize wardens. If the crop came on well, more bones and salt would be applied later on. Six acres of swedes were drilled on the flat, with 5 cwt. of dissolved bones. The surface is not rolled after sowing. Mr. Hawkins makes his own manure; he buys fresh bones at 6*l.* a ton, and applies ⅛ by weight of acid. The bones are carefully crushed, and then well wetted on a stone floor with as much water as can be absorbed; this is left for twenty-four hours; then the acid is added, taking care that the mass is thoroughly mixed; it is then covered down with ashes, and left for three or four weeks. In this way a partially dissolved manure is obtained, which appears to answer well.

Nos. 551 and 552, 33 a., of which 20 acres were laid to grass six or seven years ago, and carries an excellent face, for so young a pasture. The seeds were sown on a wheat crop, bone-dust and compost being applied. It has been well manured,

has already been mown three times, and was again laid for hay. The rest of the field was in seeds, part grazed and part for mowing; the latter, consisting of red clover only, sown with 16 lbs. per acre, was a magnificent plant. The other part was being grazed by the ewe hoggs, which would be here on and off till the first week of June, when it would be laid for seed. Nothing could look better, and the appearance of all the crops, and especially the clover, indicates a very high state of fertility.

No. 559, 8 a. 1 r. A grand crop of square-head wheat, possibly the heaviest of all.

No. 561, 34 a. 0 r. 32 p. A splendid field of white clover, grazed, and 10 acres laid for seed.

No. 538, 25 a. The meadow, bordering on the river Wye, with two fine twin elms in the centre. The lower side is deep rich soil; the upper and higher part is thin, and burns in a dry season. This field has an excellent face on it, and though so rich, not a nettle was visible, the result of careful extirpation by the fork. I may here notice that the whole of the grass-land has been drained, the landlord finding pipes, and the tenant doing labour, and a great portion has been boned. This particular meadow, for example, after being partly drained where requisite, was dressed with 5 cwt. of $\frac{1}{2}$-in. bones, and an equal quantity of dust bones, and then grazed for two years in succession with cattle eating corn and cake, which accounts for its splendid appearance.

No. 537, 34 a. Meadow land bounded like the last on one side by the Wye. This meadow is mown in alternate years, and grazed with cattle and sheep, and is usually dressed before mowing with soil and bones. This is not nearly so good a field, but it is well grazed, and in very high condition.

No. 538, 24 a. 3 r. 35 p. This is a grand meadow, which has been doubled in value by draining and boning. It is now full of rich nutritious herbage. The condition of the grass-land, due to liberal outlay and judicious grazing, is even a better evidence of good management than the excellence of the crops, and the cleanness of the tillage land. The usual acreage for mowing is 48 acres of pasture, which, as has been explained, is not always on the same land, and 18 acres of seeds, which will certainly give an average of over 100 tons of hay. There are about 30 acres of orchards, which require renovating, and as a rule there is little to sell as so much is required by the labourers. Mr. Hawkins gives two quarts of cider per day in winter, and three quarts in summer. He is fully conscious of the objections against the system, but was not powerful enough to break down the custom; he tried it for six months, giving money, and allowing the hands to buy cider, but the men were not satisfied.

The labourers comprises twenty men and boys regularly employed, and some work is done by contract. The men get from

12s. to 14s. a-week, and cider; 25s. extra for harvest, with bread and cheese at five-o'clock luncheon during the work, and twenty score yards of potato ground, equal to 10s. The carters have rather higher wages with the same perquisites, occupying cottages on the farm, for which they pay 2s. a-week rent.

The cost of labour in 1883, including all extras, was 792*l.* 0*s.* 8*d.*, equal to 1*l.* 9*s.* 9*d.* per acre—a very reasonable amount considering the large proportion of arable land and the admirable finish to everything. It was evident that labour was well handled, and that the men were under excellent control. A large area of old fences have been removed, and those that remain are carefully tended and in good preservation. The profits as regards cattle are influenced by the comparative price of store and fat animals, and hence vary more than on farms where the animals are bred; for example, 1882 was a much better year than its follower, because in the former money went much farther in purchasing, and sale prices were good. A very large capital is worked, averaging from 12*l.* to 16*l.* an acre. The valuation ranges between 6000*l.* and 7000*l.*, and the results when spread over a number of years are satisfactory, though certainly not more than might be, and ought to be, looked for from the combination of rare skill and attention, with adequate capital. It was a pleasant and instructive occupation to inspect such a splendidly-managed business, so complete in all details, and we can only hope that some reflection of our impressions may be conveyed in this Report. One point may be impressed upon our readers, viz. that the results at the Sugwas farm are not to be attributed so much to the inherent capabilities of the soil as to the admirable skill and enterprise of the most intelligent occupier. It should be mentioned that Mr. Hawkins keeps excellent accounts, which enable him to know how the different branches of his business suceeed.

The outlay in purchased food and manures for the years ending May, 1883, and May, 1884, afford evidence of the liberal treatment adopted.

1883.	£	s.	d.	1884.	£	s.	d.	£	s.	d.
Cost of purchased foods	756	7	11	.. ..				656	18	2
Value of home grown corn consumed—										
Tail wheat	15	15	0	.. .. ..	33	12	0			
Barley	31	10	0	.. .. ..	25	4	0			
				Peas	15	6	0			
				Oats	83	14	0			
								157	16	0
Cost of artificial manure	115	13	6	Cost of artificial manure				189	9	10
Total ..	£919	6	5	Total ..				£1004	4	0

Class II.—Second Prize.

Mr. Joseph Pearce, Welbroughton Farm, near Newport.

Mr. Pearce occupies on yearly tenure, under Sir T. F. Boughey, Bart., two farms adjoining each other, viz., Welbroughton, 374 acres (arable 232, grass 142), and Pollymore, 156 acres, not in competition but subject to inspection.

The agreement is not advantageous to the tenant, and considerable benefit will be derived from the new Act. The principal features are exclusion from the Act of 1875; no allowance for cake or manure purchased; the tenant is tied down to the four-course rotation, a free off-going crop on half the clover leys, or two-thirds of dead fallows; no crop is allowed on turnip-land, and no allowance is made for labour or manure. Seeing that the tillage land is nearly all free working and suitable for roots, these are very foolish conditions. The landlord supplies gates free of charge and finds materials for repairs. This is a hard and rather one-sided agreement, quite unnecessary for a man like Mr. Pearce, whose excellent management justifies more liberal terms and greater freedom of action.

At one time many years ago, Welbroughton was the late owner's home farm, and it was then laid out in the excellent rectangular inclosures which remain, and render the farm very convenient to handle. There was one tenant who occupied for ten years, between that period and Mr. Pearce's occupation, which dates from 1878.

Mr. Pearce is a grazier, indeed we might almost say that he deals in cattle, which he chiefly picks up from his neighbours, seldom buying in the open market, and there is no doubt that the financial success of his operations is in some measure due to his thorough knowledge of how and what to buy. The object is to procure animals in fresh condition, to feed them liberally, and to turn them over as soon as possible. An average of 200 cattle pass through Mr. Pearce's hands each year; and at our second visit we found very few of the same animals that were on the farm in January. It is worthy of note that, notwithstanding the large traffic in cattle, this farm has never been visited by foot-and-mouth disease.

The following Tables give a comparison of the number and description of cattle in January and May:—

January.	*May.*
30 2-year-old Hereford steers.	20 Feeding heifers, &c.
17 Bulls, 2 to 3 years old.	23 Drape cows.
17 In-calf cows.	13 Milking cows.
18 Feeding heifers.	10 Drape Hereford cows.
4 3-year-old steers feeding.	19 Herefords rising 2 years old.
1 Yearling heifer.	
2 2-year-old bulls.	
4 Cows for House.	
93	85

The two-year-old steers—a capital lot, were being fed in the yards; they cost 9*l.* a head in April, 1883, and were evidently well bought. They were getting ribbon-sliced swedes and chaff, with 3 lbs. a day of a mixture comprising cotton- and linseed-cake and crushed oats. They were all gone before our second visit, and averaged about 20*l.* The 17 feeding bulls were the remains of a lot of 30 bought in August, at an average cost of 15*l.* The rest had gone off at 25*l.* a head. Mr. Pearce considers they make within 1*d.* to 1½*d.* a lb. of the best beef. They were fed in the same way as those in the yards, only more on concentrated food, viz. 4 lbs. of mixed cake and 4 lbs. of meal. These did not do well, only leaving 9*l.* 10*s.* a head, and realising very little more than our valuation in January. These bulls were tied up on one side of a capital feeding shed, with a wide gangway, which holds 40 head. Opposite the bulls we found 17 in-calf cows. Mr. Pearce considers that he can make more profit by grazing than by dairying, and can often get three lots of cattle off during the year, which is only possible by the liberal use of cake on grass. At our visit in May, we found 17 animals feeding in the houses and yards, ready for market, and of excellent quality. A capital lot of 23 drape cows were in the meadow, and will be caked later on, and will rapidly feed. In an adjoining field were 10 promising two-year-old Hereford steers, intended for beef, and which, with a little extra food, will give a good account of themselves. Great judgment is exercised as to proportioning the class and quantity of stock to the natural produce; and a heavy outlay in purchased food enables the feeder to meet any unforeseen difficulty that may occur. From what we saw as to the mode of grazing, we should consider that the most was made that was possible, and with such excellent knowledge and judgment in buying and selling, Mr. Pearce is probably wise in his system. With most, dairying would be the surer and safer business.

Sheep are an important element at Welbroughton, the arable land being mostly suitable for feeding on. At our first visit

the ewes were running thinly over the meadows, having a few roots. The gimmer hoggs, a capital lot, were on seeds, a few swedes, and half a pound of a mixture comprising cotton and linseed-cake, lentils, malt, and dust-bran, given with a little hay-chaff. The fatting sheep, on cut swedes, had a more liberal allowance of the same; all were of useful rent-paying character and thriving well. The wethers were sold after shearing at 9*d.* a lb., weighing 21 lbs. a quarter, *i.e.* 3*l.* 3*s.* each. The ewes and lambs were grazed on seeds in May, having a liberal allowance of common cotton-cake, and were doing well. Thirty of the forwardest gimmer lambs were served as an experiment. One died, and some had dead lambs or were barren, and 21 ewes produced 23 lambs, which were looking well. On the whole, this experiment has been a success, and will probably be repeated on a larger scale. The lambs are always shorn in July. Mr. Pearce states that he has grown a greater weight of mutton since he commenced this practice. The following are the facts as to numbers:—

January.		*May.*	
164	Breeding ewes.	163	Ewes.
30	Ewe lambs served.	207	Lambs.
80	Ewe lambs, not served.	21	Year-old Ewes.
144	Wether hoggs feeding.	23	Lambs.
22	Shearling wethers do.	10	Odd lots.
3	Rams.	85	Ewe hoggs.
443		509	

The horses are of a useful, sensible type. Mares are kept and foals reared; the ordinary horse-power at Welbroughton consists of 9 working horses and two nags. We saw some promising yearlings and two-year-olds, and Mr. Pearce has a wonderful trotting cob. Food comprises 16 lbs. a day of a mixture of oats, beans, and bran—one-third bran.

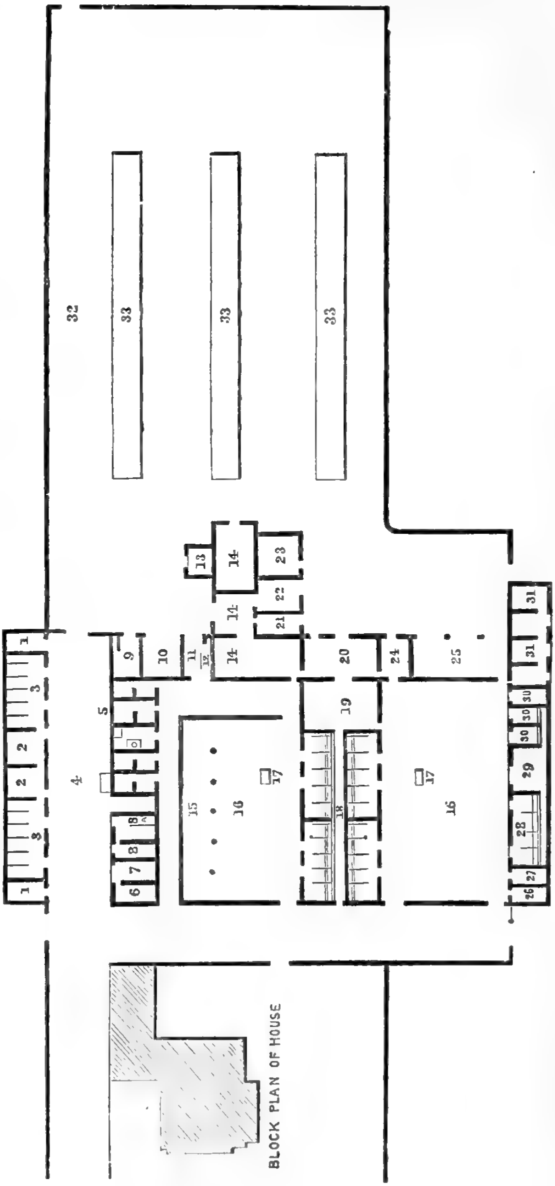
Poultry are an important element. Mrs. Pearce supplied the following particulars of stock at our first visit:—

40	turkeys.
101	Irish geese.
70	fowls.
20	guinea fowls.
231	

A small number of pigs, about a score, are fed throughout the year.

The situation of this farm is particularly attractive, commanding lovely views of the town of Newport, Sir T. Boughey's

Fig. 6.—Plan of Welbroughton Hall Farm-buildings.



1. Loose-box.
2. Gear-house, loft over stable.
3. Waggon-house.
4. Stable yard.
5. Piggeries, &c.
6. Harness-room.
7. Coach-house.
8. Hay-house.
8A. Nag-house.
9. Implements.
10. Cart shed, granary over.
11. }
12. } Implements and tools.
13. Tools.
14. Barn.
15. Cattle shed.
16. Fold-yard.
17. Tanks.
18. Cow-house.
19. Mixing-room.
20. Turnip-house, loft over.
21. Engine-house.
22. Barn, room over.
23. Guano-house.
24. Crop-house.
25. Waggon shed.
26. Hen roost.
27. Loose-box.
28. Cow-house.
29. Turnip-house, loft over.
30. Loose-box.
31. Sheep sheds.
32. Stack-yard.
33. Rick-frames.

richly-wooded park, with a peep at Aqualate Mere beyond, a sheet of water covering 200 acres, and adding much to the beauty of the landscape. The house is good and substantial, and the buildings roomy and fairly convenient. Formerly both the large yards were unprovided with shedding, but Mr. Pearce has, at his own expense, erected a capital shelter shed with an iron roof. The other yard would be greatly improved if entirely covered over, for which outlay a good interest could be paid. At the east end of the feeding-house already noticed is a large space divided into a root, store, and mixing-room. Above the root-house is a chaffing floor, the chaff being conducted by a spout into the mixing-room. Mr. Pearce prefers slicing to pulping; cattle eat more, and the roots, he thinks, remain longer in the stomach, and so more nourishment is extracted. Whether this latter is a fact we do not know, but the fattening animals have as many swedes as they can eat, with wheat straw, and a little hay in racks, and about 4 lbs. of chaff a day. No rock-salt is used.

The cart stable, which is a separate building on the opposite side of the range, is roomy, well-ventilated, and fitted with iron mangers and racks, with a harness and hay-room in the centre. All liquid drainings are collected in a tank.

The farm is well roaded, and is intersected by a railway; the higher side is principally arable. The soil varies considerably, is very thin in places, and here and there are waste patches where the sandstone rock comes to the surface. The enclosures are large, and the fences admirably kept. Judging from the large twitch heaps which we found rotting down in No. 1456 and other fields, and which were utilised to grow potatoes on, and which were got out in preparing for roots last year, we should credit Mr. Pearce with having well cleaned land, that was foul on entry. This decayed matter was to be mixed with lime before application either to seeds or grass. At our second inspection in May, we found most of the crops in promising condition, the land generally clean, and one large field, No. 1412, for roots, not then sown, in excellent state. One field of white spring wheat after seeds was suffering in some places from the daddy-long-legs grub, which, despite careful hoeing, must result in a patchy crop; this field had greatly improved in July, and promised more than an average crop. Another field, No. 851, was sown with mangolds and swedes, 7½ cwt. of manure, supplied by the Cannock Chase Company, having been used; both mangolds and swedes were doing well. Mr. Pearce experiences some difficulty in getting his seeds to stand every fourth year. Manure is principally applied either on the young seeds in autumn, or the following year for the wheat crop.

The grazing of the meadow lands, and their improvement by a large consumption of cake and by the use of bones, of which Mr. Pearce uses more now than when he first became tenant, have proved their value in developing good herbage, and are most commendable features of the management at Welbroughton. We had a striking instance of this in the case of No. 833, Longwood, a tract of nearly 48 acres, which, as its name implies, was probably once a forest. At any rate, judging from the appearance of the land on the other side of the road, it would without good farming be very inferior grass. The colour and quality of the herbage afforded a striking contrast to the wretched stuff referred to, brown in colour and filled with rushes and bad grasses. Two dressings have been applied; that of last year consisted of 5 cwt. of bones and 3 cwt. of phosphate per acre; a portion at the farther side was not so treated, and the difference both in colour and herbage was very apparent. In May this field was carrying a score of young heifers, one- and two-year-olds, 55 ewes, and 80 lambs, and there was abundance of food. This field illustrates the advantage of liberal treatment, and also how greatly present condition is due to the tenant's capital, for the unexhausted portions of which the Act of last year will give him compensation. Another evidence of the value of bones applied and cake consumed on grass-land is the fact that now half as many more cattle can be grazed as at first. On both our visits we inspected the Pollymore farm, which was well stocked and equally creditable. Inasmuch as the two farms are worked together, it is not easy to separate the outlay in labour; but, taking the whole and averaging the amount, we get 1*l*. 5*s*. an acre, made as follows:—

	£	*s.*	*d.*
3 Waggoners at 15*s*. a week, one only with cottage, valued at 5*l*. 3*l*. each extra for corn-harvest, and beer money for hay time, 10*s*.	132	10	0
Shepherd at 16*s*. a week. 2*l*. for lambing, cottage, and extra as above	52	2	0
6 Labourers at 14*s*. a week. Extra at harvests = 39*l*. 18*s*. each	239	8	0
3 Boys at 4*s*. 6*d*. a week	35	2	0
	£459	2	0

The outlay in purchased foods for the whole farm of 530 acres was in 1883, 723*l*. 16*s*.; to this must be added the value of home-grown grain consumed, 200*l*.; total, 923*l*. 16*s*., equal to 35*s*. an acre. The cost of artificial manures for the same year was 294*l*. 11*s*. 7*d*., or 2*l*. 6*s*. per acre as the cost of foods consumed and manures purchased over the whole occupation, which indicates very high farming. The valuation at Christmas 1883, amounted to 5240*l*. 10*s*. over the whole area, and Mr. Pearce

considers he is employing fully 12*l.* an acre capital. The returns are more variable than on a breeding farm, as they are influenced so much by the comparative values of horned stock when purchased and sold. With Mr. Pearce's judgment, the system he pursues is doubtless wise; but his are exceptional circumstances, and the man who breeds and rears his stock is contributing more to the general weal.

From the appearance of the crops in May, and the excellent condition of the land intended for roots, we expected at our last visit in July to find a more prosperous condition of affairs than existed; but the long dry time had told upon the cereals, which, though generally level good crops, were not of that luxuriant growth which, under other circumstances, might have been confidently anticipated; but, more serious still, a large proportion of the first sowing of roots had been destroyed by a terrible infliction of fly, which were still far too busy on July 11th—a very unusual visitation. When all hope of the crop was gone, Mr. Pearce had split the ridges and redrilled, and the young plants were looking well, though by no means out of danger. The mangolds, which were terribly mauled by the maggot of *Anthomya Betæ*, were so ragged a plant that swedes had been gapped in in the intervals. The land was most satisfactory as to tilth and cleanness, not only on the root break, but throughout the farm. The first rain of any account fell at Welbroughton on June 29th. After the careful and thoroughly business way in which the farms had been handled, and everything done that was possible to ensure a success, it was disappointing that causes beyond control had so seriously interfered with results. We found some additional stock purchased since May, viz., on the two farms 30 head of cattle and 100 sheep, but none sold; the land was fully stocked, yet there was abundance of food in the pastures, and all kinds of stock were in thriving condition.

Class 2.—Third Prize.

Mr. Henry Minton, Montford, near Shrewsbury.

Arable	300	acres.
Grass	240	„
	540	„

Mr. Minton occupies under the Earl of Powis, on the Lordship Estate, having in 1878 succeeded his uncle, the late Mr. William Matthews, who was at one period so successful as an exhibitor of Shropshire ewes; and it may be mentioned that

Messrs. Crane and Tanner, and Mr. Bowen-Jones, well-known sheep-breeders, are his neighbours on the same estate, the light and friable character of the tillage land which largely prevails being well suited for sheep, whilst the useful meadows on the banks of the Severn make good rearing ground for the valuable Hereford cattle, and grand cart-horses, which, after the flock, are the pride of Montford. Mr. Minton, who holds the diplomas of the Royal Agricultural College and the Royal Agricultural Society, has not been idle since he took the farm, and much work of renovation and improvement has been carried out by landlord and tenant, the latter having grubbed up a large area of useless fences ($2\frac{1}{4}$ miles), and planted new fences where requisite. The landlord has supplied half-a-mile of continuous iron fencing, for which a very reasonable interest is charged. The work was in progress at our first visit. The noble owner has made great alterations and additions to the buildings, the tenant finding horse-labour. The principal business has been the conversion of an open shed into a summer sheep-house, and the filling up of rough uneven ground to make a suitable outrun, and the construction of a capital shelter-shed for the open yards, which are fenced with stone posts, and two-inch gas-piping, the lowest rail being cleverly made use of as a water-pipe. I regret that I am not able to give a ground plan, to illustrate what may well be regarded as most suitable appliances for a speciality, viz., the preparing sheep for show and sale purposes.

Although Mr. Minton has been principal for so short a time, he found good material to work upon, and has made his mark, both in the showyard and the sale-ring, "Montford Hero," the first prize shearling at Derby, having been let by auction to Messrs. Crane and Tanner for the season at 205 guineas, the highest figure on record. He again was successful at Reading, where he stood first as a two-shear, and was let for 70 guineas. Last year, 1883, he was used at home, and is likely to work for another year or two. The money prizes won by this sheep amount to 80*l.* At the same sale referred to, *i.e.* in 1881, a pen of shearlings made 30 guineas each, and last year the average of the draft shearling ewes was 9*l.* 13*s.*; and Mr. Minton states that the average annual price per head of sheep of every description sold during the past four years is 10*l.*

In January we found 132 in-lamb ewes, a splendidly even lot as to size, and very matching in character, 69 ewe lambs and 91 tup lambs, with three or four older rams, making a total of 296 head. All the males are reared entire, the drafts going to the butcher, when found not good enough for service. The tup lambs were on roots sliced, and having $\frac{3}{4}$ lb. of cake and peas per diem, with chop and a little hay. The ewe lambs were similarly treated,

only having ½ lb. of linseed-cake per head. Very high feeding in early life is not approved of, as the risk of loss is increased. The lambs have but little corn until weaned in July, and are kept during summer chiefly on first and second year's seeds. The rams remain out till shorn on April 1st, after which they are housed. At our second visit in May the new sheep-houses were completed, and here we found 30 shearling rams, 5 or 6 in each compartment. Although the weather was warm, the building was cool, owing to excellent ventilation arrangements, and the animals were evidently thriving well. They were big good sheep, with uniformly dark faces. A few roots were stored for their use, but the ten weeks of dry weather had sadly interfered with the growth and succession of spring forage crops, cabbages, &c., which are relied upon for the necessary changes of food. Out of these sheep the Shrewsbury exhibits would be selected. One of the shearlings was most promising. We were favourably impressed with a two-shear, "Procrastination," by Mansell's "Lordship 2nd," not shown last year, owing to a mistake as to the entry. He was let to Mr. Loder as a shearling for 50 guineas. A pen of shearling ewes are also being prepared, very pretty, but not remarkably big. Forty shearlings are sold by auction each year with the draft ewes. Two breeding ewes were killed by dogs getting amongst the flock, which did considerable harm besides, otherwise the lambing season had been successful. And the lambs were a promising lot, and have been shorn this year for the first time. Excessive forcing, either of animals or crops, is avoided. The natural excellence of the tillage land produces crops of such quality that very heavy manuring would be injudicious. This may be judged of from the fact that the average outlay in cake and manure does not exceed 1*l.* an acre. The corn crops, especially the barley, were excellent. The latter, which is largely grown, was particularly heavy on one large field after seeds, No. 468, and it was open to argument whether this or the small field No. 465 would prove the better. Both would give a good account of themselves. The wheat was an even full plant, and looked like casting well. The light friable soils of the larger portion of the farm are favourable for barley of high quality. Mr. Minton finds great benefit from the application of small doses of lime, from 30 to 40 cwt., every four or six years, and such treatment is carried out systematically. The root-break, partly owing to dry weather, did not present such a satisfactory appearance as the corn crop. The mangolds were a rather ragged lot, and the swedes were late and uneven, but with an open back, and may make a fair amount of food.

The Hereford cattle are receiving more attention as to the registration of pedigrees than before the American trade was

established. They are, however, well bred, and most of them are qualified for the Herdbook. At our first visit we found 94 head, increased to 99 in May, and comprising a very useful lot of 32 cows; 22 two-year-old steers grazing, which in May were replaced by 25 sucking calves; and young store animals, including 8 young bulls, for sale; a yearling bull, by Mr. Rogers's "Assistant," destined for service, and promising enough if his ribs spring a bit; also his sire, a three-year-old, very wide forward, with ugly horns, set back, and rather slack ribs, but with thick good flesh; and a two-year-old, preparing for show; also four yearling heifers, by "Assistant," to be shown together, a useful, but not matching lot. Like the sheep, very natural treatment is followed. Thus the cows in winter range the pastures during the day, when they have a few swedes to bite, and plenty of sweet straw in racks at night. The young stock are chiefly by "Assistant." This is the first year that bulls have been bred.

The pigs are a superior class of Berkshires. We saw eight grand sows and gilts, and a boar of Swanwick's.

Cart-horses are a notable feature at Montford. The total number of horses in May was 19, viz. 10 working horses (4 in-foal), 4 yearling colts, 2 nags, 3 various. One grand brown mare, "Montford Meg," by "Black Prince" (169), has proved an exceptionally good breeder, and is the dam of "Cannock Enterprise," by "Statter's Heart of Oak" (1003), which was sold as a yearling to the Cannock Chase Company, and, after taking first and champion prizes at Islington, realised 1000*l*. It is highly creditable to Mr. Minton's judgment that he should have bred the highest-priced sheep and one of the most costly horses in the country. We also noticed a powerful five-year-old black mare, a black colt foal by "Somersham Samson," a chestnut colt, and two fillies of considerable promise.

The arable land is principally worked on the four-course system. The seeds are occasionally left for two years. Some of the least desirable land has been laid to grass, mostly by the tenant, some by the landlord. Much of what we saw was rough, and not so successful as might have been expected. Possibly this may arise from some defect in grazing, or from no bones having been applied. Since Mr. Minton's tenancy about 56 acres have been laid to grass, for 40 acres of which the tenant found seed. It was evident that more attention might advantageously be given to the improvement of the pasture land, which up to the present time has not been so well treated as the arable. It is in the management and character of Mr. Minton's stock of all kinds that merit is most conspicuous, and the Judges were unanimous in their wish that the excellent management of live-stock should be recognised by the award of an extra prize, which was at once granted by the Council.

Class II.—Highly Commended.

Mr. Thomas Griffin, Preston Vale Farm, near Penkridge.

Arable	.. .. ..	196 acres.
Grass	.. .. ..	89 „
Total	..	285 „

This farm is occupied on yearly agreement under Lord Hatherton. The soil is a strong red loam, nearly all heavy, and awkward to work. The grass-land is partly upland, but principally meadows, injured by the flooding of the Wistow, a straggling brook, which bounds the farm on the south side.

The farm is admirably laid out. A road made by the tenant runs north-west from the buildings, right through the centre of the largest plot, with conveniently shaped fields on either side. These fields have been principally laid out by the tenant, who has planted 3200 yards of new fences, and has stubbed up nearly double this quantity. The landlord supplied materials, and some assistance in the labour. The result of all this outlay is that the farm is very ship-shape, the fences are excellent, and the whole appearance trim and businesslike.

The tillage land was perfectly clean, and in high condition. Here, as at Stafford, the practice of marling strong land was formerly carried to excess. Marl-pits in nearly every field occupy valuable space, and indicate to what an extent this practice prevailed, which doubtless increased the yield of wheat, but injured the mechanical condition of the land. The land is winter-ploughed with three stout horses in line. The usual rotation is a modified four-course. Two corn crops are occasionally taken, and the general cleanness of the land renders such a practice allowable. There are no restrictions as to cropping or sale. Steam cultivation is hired in spring for working the fallows. All the crops were most promising. Wheat and beans were especially good. The land for roots is carefully and judiciously cultivated; thus, field No. 1749 was ploughed in the autumn after wheat; it was steam-cultivated twice in early spring, twice ploughed afterwards and worked, ridged after 6 cwt. of dissolved bones had been applied broadcast, then a scuffler run up the furrows, and the ridges were split back on the land thus deeply stirred; and judging from the excellent crops which were being consumed at the time of our first visit, I think this treatment must be advantageous. The bone manure was obtained from the Cannock Chase Agricultural Company, Limited, costing 7*l.* to 7*l.* 10*s.* a ton. The seeds, which are grazed down by sheep in spring, and then laid

for hay, were an excellent crop, and afforded invaluable food for ewes and lambs. Indeed, the arable land generally was thoroughly well handled, and we were particularly impressed by the fact that Mr. Griffin manages to feed a considerable proportion of roots on the land without losing the next corn crop, or injuring the sheep. We were not so favourably impressed as regards the grass land, much of which was badly grazed, and rough in consequence. To some extent its present appearance is due to the fact that less cattle are kept than usual, owing to the difficulty of buying what would pay, but we were of opinion that more might be made of the grass-land.

Shropshire sheep are carefully and judiciously managed at Preston Vale, and it is no easy business to grow roots and feed them off on land which has so much clay in its composition. On our first visit we found the mixed hoggs, 169 in number, in field No. 672, eating a considerable proportion of a heavy and regular crop of swedes on the land; iron hurdles, 6 ft. long, are used for folding, costing 8*l.* 10*s.* a ton, *i.e.* 56 hurdles, about 3*s.* each. These last a long time with care and occasional overhauling, and are cheaper in the long run than either wooden hurdles or netting. The hoggs were close shorn in July, a practice tried here for the first time, but which is apparently becoming general throughout the Shropshire district. Besides the roots, they were having an allowance of mixed cottonseed- and linseed-cake, and were quite forward enough, considering that the wethers are not intended for the shambles after clipping, but for summering on the meadows, where we found them in May occupying a good deal of ground that might have been more profitably used, and having $\frac{1}{4}$ lb. of beans with a little steamed chaff. By this method they make out heavy sheep, 22 to 24 lbs. a quarter, but we question if they pay for the extra keep, and believe that it would be more profitable to finish them on turnips, or as soon after shearing as possible, and so to save all the summer grass for young cattle. The sheep stock in May consisted of—

109	ewes.
193	lambs.
4	barren ewes.
80	shearling wethers.
77	,, ewes.
1	ram.
464	

The ewe flock varies from 112 to 120. These are very grand animals of excellent type, wide frames on short legs. We found them in the winter living on grass-land, which formed

their main food, with a few swedes given whole, some steamed chop and malt dust. They were in splendid condition. In summer the ewes and lambs (the latter were wonderfully level and of good character) are kept chiefly on seeds, of which the take is extremely good, the ground well covered, and all the sorts fully represented. The practice is to sow part of the Italian rye-grass on the furrow, and the remainder is drilled with the barley, by which arrangement necessary depth of soil is secured; 12 to 15 lbs. of mixed clovers are lightly drilled across the corn. Nothing could be more satisfactory than the young seeds, indicating, as was apparent in other crops, that the arable land is liberally and judiciously managed at Preston Vale.

Cattle are the weak feature of the management; with land well adapted, as far as we could judge, for rearing stock, Mr. Griffin contents himself with buying in a small number of store animals, partly for feeding in the byres and partly to be kept a year as stores for summer grazing with the shearling sheep in the meadows. The ordinary stock in winter numbers forty-five head. This last winter, owing to the difficulty of getting stock, there were only thirty-six, of which fourteen were useful feeding heifers and steers, bought dear in the autumn, and which could not pay for their food; six smaller heifers, and sixteen useful steers, destined for the meadows, where we found them on our second visit. More cattle might be kept if the roots were pulped instead of being sliced, and this is the more desirable, inasmuch as excellent arrangements exist for steaming, chopping, &c. The stock in May comprised 14 fat heifers, 10 barren heifers, 2 in-calf heifers, 2 cows in-milk, and 9 steers, making a total of only 37 head.

The cart-horses are strong animals, well suited to work such land. The heavy labour may be judged from the fact that, notwithstanding the occasional use of steam-power, 196 acres require nine cart-horses; but some foals are bred, which reduces the efficiency of the teams. There were 2 foals, 2 two-year-olds, 2 yearlings, 1 old mare and foal, 1 cob, and 1 pony; total, 19.

The buildings are well contrived, and afford much accommodation, with three open but well sheltered yards, which are reached from the feeding passage of the cattle shed, so that feeding is economically performed. The arrangements for preparing the food are convenient and suitable, comprising a small horizontal engine and large boiler, pair of grindstones, chaff-cutter, &c. The chaff is closely pressed in a chamber, steam being introduced through a perforated floor. The cart-horse stable is very roomy, with a feeding passage at the head. This building was originally a cow-house.

Labour is extremely well managed. The total outlay averages 23*s.* an acre, comprising—

2 Waggoners at 15*s*. a-week, cottage, &c.
1 Shepherd at 15*s*. do. do.
1 Shepherd's assistant at 14*s*. a-week, cottage, &c.
Head labourer at 15*s*. a-week, and cottage.
1 Lad at 10*s*. a-week.
1 Irishman at 12*s*. a-week.
2 Waggon-boys at 5*s*. each a-week.

Extras at harvest, 21*l*. Each man gets 3*l*. 5*s*. extra, and no beer. Mr. Griffin disapproves of the system of giving large quantities of beer and cider. Five cottages are included in the occupation.

Before leaving Class II., I must allude to a circumstance of very sad import, the only sorrowful incident of our work. Huntington Court Farm, near Hereford, was entered by Mr. Thomas Goodwin, The Court Farm, Hampton Bishop, Hereford, being an off farm in his occupation, principally valuable for winter keep of stock, grazed in summer at the home farm. Mr. Goodwin was well known as an energetic and successful manager until a recent period, when he was struck down by paralysis and deprived of powers of speech and locomotion, though retaining his faculties. On our first visit he was present, accompanied by Mrs. Goodwin, whose devotion was most evident. Since his affliction she had studied business matters, in order to release him as far as possible, and with the hope that in a few years the eldest boy, a lad of seventeen, would be equal to take the helm. In this work she was ably seconded by the foreman, Thomas Price, whom she strongly recommended for a certificate, as a faithful, zealous servant of thirty years' service. At our second visit, both Mr. and Mrs. Goodwin were dead, and, curious to relate, she died first, and he, struck down by grief at her loss, soon followed. Although there were elements of great interest in the farm, notably the very heavy stock kept and their general good character and condition, matters were so completely upset, that neither Thomas Price or Mr. Evans, the trustee, could afford such information as would justify publicity, and therefore we were reluctantly compelled to close the page upon what at our first visit promised to be a valuable record. We were, however, thoroughly satisfied as to the valuable and honest services of Thomas Price, whose name and history are given at the end of the Report, and whose recommendation by his late employers we most heartily endorse.

There is just one other point that must be noticed before quitting this portion of the Report. Amongst the entries was a farm of 185 acres at Bolus Magna, occupied by Mrs. Ann Jefferies. Having only been occupied for three years, and

entered on in a wild neglected condition, with very dilapidated and insufficient buildings, this farm was not fit for exhibition. And the special object of this brief notice is to draw attention to the industry, enterprise, and perseverance of Mrs. Jefferies' son, who has managed for his widowed mother here and elsewhere for thirteen years, and being only ten years old when his father died, and has succeeded in not only holding his own in the face of great difficulties, but has steadily improved the condition of the farm, and made handsome profits. This has been mainly due to judgment in the management of a small butter dairy, combined with the rearing of calves, by keeping an excellent class of Shropshire sheep, and, above and beyond all, by individual attention and industry of an unusual and most commendable nature. And it appears that this successful result is all the more meritorious from the fact that Mr. Jefferies has lacked the opportunities of many of studying agriculture in a scientific aspect, and therefore may not always know how to make the most of his opportunities ; for example, we noticed that in the matter of artificial manures for the root crops, phosphates—the most important constituents—were omitted altogether, and this in a soil of a sandy nature and derived from a formation destitute of phosphatic materials. He was using a mixture of soot, kainit, and salt, costing only 17*s.* an acre, and this was the only assistance given directly to the crop. If Mr. Jefferies, who is very intelligent, becomes a member of the Society, and occupies his winter evenings in reading its 'Journal' and other agricultural literature, he will be able to amend his practice in those particulars in which it is not entirely in harmony with scientific teaching. The Judges were so impressed with the devotion of the manager to his work that they consider him to be most worthy of a certificate, and recommend him accordingly.

Class III.—First Prize.

Mr. Charles Miles, Tatenhill Farm, near Burton-on-Trent.

	A.	R.	P.
Grass	81	0	20
Arable	46	0	0
	127	0	20

Tatenhill Farm is held on yearly agreement under The Agricultural Holdings Act, 1875, from Sir John Hardy, Bart. More than one-third of the pasture-land has recently been laid down

by the tenant. Tatenhill is three and a half miles distant from Burton-on-Trent. The land is not conveniently situated as regards the buildings, but the more distant portion, mostly arable, adjoins the Trent and Mersey Canal, and town manure from Burton is delivered on the farm at 3*s.* a ton; also night soil in a semi-liquid condition, at 2*l.* a boat-load, which, mixed with ashes, is good manure for root crops.

This is an important advantage, especially as up to this spring the road through the farm was only a mud lane, almost impassable in wet weather, and a source of much extra horse-power and wear and tear both mechanical and mental. We were very glad to find on our second visit in May that this road which had been such a source of trouble was being repaired. A nine-feet width of surface was being excavated 12 inches deep, with a pipe-drain down the middle, and drain and excavation filled with thorns. This was to be covered with gravel quarried on the farm, and conveyed by go carts. The landlord was to do the work, and the tenant to lead materials, which, as the road reaches fully half a mile, is no small undertaking, and was very properly interrupted at the time of our visit, in order that fallowing operations might be proceeded with. Seeing that the arable land can be manured from the canal, and that the field close to the buildings, is suitable for roots, it is questionable whether the system of carting most of the roots such a distance and hauling back manure is judicious or economical. It might be wiser to consume the bulk of the roots in these far-off fields on the ground, and depend more on artificial food for the cows.

The soil varies considerably: two arable fields on the south-west boundary are of a peaty character; the rest of the tillage land is on a gravelly subsoil, with occasional patches of strong soil, which makes it awkward to work. This portion is mostly of a somewhat poor, hungry nature. The grass-land is a strong loam on a clay subsoil, and to some extent requires drainage. It may be truly said that the remarkably successful management which we are about to describe is mainly due to the energy and perseverance of the tenant, ably backed up by an excellent wife, in the face of difficulties and discouragements which to many would have proved insurmountable. Indeed, Mr. Miles's history is so instructive, and he is so truly typical of the class of man likely to make small farming profitable, that no apology is offered for giving a detailed account of his experience, which, as well as the financial results, are published with the full consent of Mr. Miles.

Charles Miles was born in 1841, at Hill Ridware, near Rugeley, Staffordshire, where his father, who had previously

been a butler in a gentleman's family, occupied a public house, the Chadwicks Arms Inn, and a small farm. His mother was, before marriage, a laundry-maid. Hard work was the order of the day, and young Miles had but little schooling, having to work on the farm and help to brew until turned sixteen, when he went into the Queen's stables as an outrider. At nineteen he was obliged to give up service and take the place of an elder brother, deceased, as his father's health had given way. Here he struggled on for a period of nine years, being heavily handicapped, and eventually well-nigh ruined through his mother's intemperance. At the age of twenty-three, two years after his father's death, he married his first wife. The farm was made over to him, the public-house being kept on by his mother, who was soon sold up, and, through helping her, he was also obliged to give up the land. This proved the starting-point of his career; his wife's parents lent him capital at 4 per cent. interest, and with this he took a poor farm of 182 acres on Needwood Forest, two-thirds tillage. All interest and principal were repaid. He had 300*l.* with his wife, most of which went to pay debts incurred before entering on the farm. And this was all the capital he ever had. After occupying the farm for about six years, Mr. Miles lost his wife, whose parents had died before. This was a great trial, as he was left with two children, one a baby. The wife's sister came, but died the following spring. Then, in despair, the mother was sent for, but the curse of drink was still at work, and she had to be sent away, or the poor fellow would have been ruined a second time, but by great perseverance and industry he pulled through. A year after his first wife's death, he married his present wife, and this was, he states, the luckiest day of his life, for, though his first wife and her parents gave him the start, number two, who came empty-handed, was a fortune in herself—a statement which from our observation was by no means mere hyperbole, for a more efficient and willing helpmate to a hard-working energetic man could not be imagined. She was the daughter of a farmer, but, left an orphan quite young, was brought up by relations. After this happy marriage things prospered, and notwithstanding the unfavourable character of the farm and heavy losses experienced, after nine years' occupation money was saved and stock increased. The farm was eventually given up, owing to serious injury from rabbits, which he was not allowed to destroy, and Mr. Miles came to Tatenhill at Lady Day, 1874; at that time the extent of the occupation was 114 acres, and did not include five fields immediately below the house, but took in some outside land, now given up. The rent and tithe amounted to 52*s.* 6*d.* an acre. The farm was, accord-

ing to Mr. Miles's report, in a very bad state; the plough-land was so wild that the whole had to be summer fallowed; for this purpose steam-power was hired. The off-going tenant's last crop of wheat upon wheat was absolute rubbish, and was burnt upon the ground. He was an excellent man and a clever barrel-maker, which was his trade, but did not understand farming, and consequently during his six years' occupation dropped his money, and left the farm in a wretched state. In 1878, an exchange of lands allowed of an important alteration in the holding. The five fields alluded to, comprising 37 a. 1 r. 13 p., were added, and outlying lands comprising 24 a. 2 r. 8 p. were taken from the farm. Nearly three-fourths were strong tillage land, requiring to be summer fallowed, the rest poor grass-land. Rent and tithe was lowered to 42*s.* 6*d.* an acre, which, as far as we could judge, is a good rent. At this time the farm comprised 48 acres of old grass and 79 of tillage, a proportion not suitable for dairy occupation; and Mr. Miles, as soon as the land was clean, laid down the whole of the newly-acquired arable land near the homestead and two fields at the other extremity of the farm. These fields look extremely well, they have been manured or dressed with compost every year since they were laid. The land was first thoroughly cleaned and well manured. The seeds, supplied by F. Dixon and Son, Chester, were sown in wheat, and usually grazed the first year, mown the second year, and dressed as above. The landlord found part of the seeds. Mr. Miles varies the mowing-ground, by which plan he prevents any of it becoming rough and coarse, as it would do where the manure was dropped if always grazed. All manure to grass-land is applied in the autumn. Great care is exercised to have the clots well distributed. Mr. Miles states that the first year he occupied the farm the whole of the corn was represented by one small oat-rick, whilst last year with much less tillage-land the rickyard was not large enough to hold the corn, and a barley-stack was thrashed out to make room for the beans. Amongst the improvements carried out by the tenant may be mentioned the leading of all materials for the farm-buildings, which are excellently adapted for the requirements of the farm; the filling up of the old manure-hole opposite the dairy, which caused a stench which was most unwholesome; placing new drains, &c., making new roads about buildings and a new pond; fences and ditches improved all over the farm, and now in very creditable condition; planting fruit-trees in garden and fences; and doing the labour of a lot of drainage, locally known as "soughing," the landlord finding pipes; some draining, particularly in one of the peaty fields, was entirely done by the landlord, of whom the tenant speaks in the highest terms, expressing the greatest confidence in his

justice and liberality; an evidence of which is the fact that ever since 1878 returns varying from 10 to 20 per cent. have been made. Mr. Miles says, "I have had a hard uphill fight, but think I may say, with the help of Providence and good seasons, if I have my health and strength with good luck, I have a bright remunerative prospect before me. I shall endeavour to still go on improving the farm and increasing my stock to its fullest possible extent, and hope to be able to very much increase the produce. I never go away from home except when business obliges me to do so. I go to work down the fields with the men all day, that is, when work is going on, on the land, till milking time, five o'clock, taking a bit of lunch in my pocket; these are my happiest days, as I can get so much more work done when I am amongst it and helping to do it: I never indulge in any luxuriant extravagance for myself and family." This last assertion is proved by the extraordinary experience which has been related, for such success could only be possible with untiring industry and severe economy. On our first visit in January we reached the farm at an unexpectedly early hour, and found the husband and wife in their working gear, each busy with their respective departments. The farmer would apologise, but we assured him that he was in such guise doing infinite credit to himself. Nor must we omit to mention that the eldest boy of the second family had begged a holiday, in order that he might see the judges and that they might see his rabbits, of which he was evidently a most successful breeder, and thus early gave evidence of his taste for live stock. The family comprise a boy and girl by first wife, the former apprenticed to a grocer, the latter at home helping with the house-work, and three children at the National School, and the youngest at home.

The buildings are excellent, and provide much accommodation, which is fully occupied; indeed, the cart-shed we found converted for the nonce into a habitation for young stock; most of the implements were carefully stowed away in a hovel, whilst two waggons, only used in harvest work, were loaded with beans and carefully thatched down, so as to be thoroughly protected from the weather. The buildings include two roomy well-contrived cow-houses; a capital yard, covered with galvanized iron, which extends right up to the dairy buildings, which are an extension of the house; and though this affords a convenient and protected covered way for the delivery of the milk, it must be rather a nuisance at those times that the manure is being removed. There are two or three boxes for calves, stables, boxes, and the cart-shed already mentioned; whilst, on the other side of the house and roadway, is a big barn for straw,

with a floor over for chaff-cutting, and a mixing-room, granary, &c., and piggeries under. The manure not accommodated in the covered yard is made into a heap below the buildings, and all the liquid from it wastes away. It would be a great improvement if it were covered with a light roof, so as to protect it from rainfall.

The dairy comprises 25 to 30 cows of good milking character, and mostly of Shorthorn type. At our winter visit we found 30 cows in-milk and dry, 8 in-calf and barren heifers, 9 rearing calves, and 2 grade bulls, *i.e.* unpedigreed Shorthorns. At our second visit the total was increased by weaning calves to 56 head. The bulls are carefully selected as the offspring of heavy milking cows by a pedigree sire; they are serviceable animals, not smart or showy, and, as Mr. Miles rears a portion of his stock, the use of such animals is questionable policy, seeing that well-bred animals from good milking strains are so readily procurable. Being so near to Burton, grains are largely used, the ordinary prices being 4½*d.* a bushel in winter and 2½*d.* in summer, a variation sufficiently great to render storing in large quantities desirable. A certain quantity can be laid up, but not nearly enough, and Mr. Miles spoke of amending his practice in this matter. Each cow in winter gets a bushel a day in two feeds, 4 lbs. of mixed linseed and cotton-cake, and two feeds of turnips and cabbage, followed later on by mangolds, from 30 to 40 lbs. a day, and tops with hay and straw *ad libitum.* This is liberal feeding, but we were surprised to find that, though Mr. Miles has all the machinery, including steam-power, for reducing the food and mixing the ingredients, he preferred to deal with them separately, probably on account of the saving of labour. In times of scarcity he approves of pulping, chaffing, &c. A considerable loss has occurred from abortion, for which no explanation has been found. Can this be the effect of grains, which are not always considered wholesome food for breeding animals?

At our visit in May, we found the cows, thirty in number, in their pasture, and were much pleased with their thoroughly useful character; 46 acres of grass are provided, which they have in common with the horses; they are brought home to milk, getting a bushel of grains to three cows, and 2 lbs. a head of decorticated cotton-cake. In order to keep up the milk-supply during winter, when prices are highest, some down calvers are bought each autumn, but the bulk of the herd are bred. As a precaution in hot weather, or when cows are fresh, a dose of salts is given before calving. The list is as follows: 30 cows in-milk, 2 feeding calves, 1 cow dry for calving, 3 in-calf heifers, 1 barren heifer, 3 yearling heifers,

2 winter-reared calves, 4 young bulls, 8 rearing calves, 2 bulls in service; total, 56 head. Most of the calves are sold as soon as capable of removal. Those reared are removed at birth and brought up by hand, having new milk from 10 days to 3 weeks, according to circumstances; then gruel made with dust oil-cake, lactina, and oatmeal, all scalded and added to the old milk, mixed up twice a day. As soon as the calves can eat, they have sweet hay, cake, grains, &c., being weaned altogether at 8 or 10 weeks from birth; they are well kept, and always have a little cake. Those we saw were in thriving condition. Most of the milk is sent to Birmingham from Barton and Walton station, three miles from Tatenhill. The contracts, carriage paid ($\frac{1}{2}d.$ a gallon) are as follows:—

For the month of October	.. ..	$9\frac{1}{2}d.$ per gallon.
November to March, inclusive..	..	$10d.$,,
April to September, inclusive ..	..	$8d.$,,

In winter, there is one delivery a day, viz. 7.30 A.M., at the station; in summer, both morning and evening. The following details are interesting:—

Months.	1882. Produce of 24 Cows. Gallons.	Value. £	s.	d.	Months.	1883. Produce of 27 Cows. Gallons.	Value. £	s.	d.
January ..	1,204 at $10d.$	50	3	4	January ..	$1,410\frac{1}{2}$ at $10d.$	58	15	5
February ..	1,403 ,, ,,	58	9	2	February ..	1,475 ,, ,,	61	9	2
March ..	$1,316\frac{1}{2}$,, ,,	54	17	1	March ..	1,943 ,, ,,	80	19	2
April ..	1,135 ,, $8d.$	37	16	8	April ..	1,432 ,, $8d.$	47	14	8
May	1,506 ,, ,,	50	4	0	May	1,399 ,, ,,	46	12	8
June	738 ,, ,,	24	12	0	June	1,322 ,, ,,	44	1	4
July	2,055 ,, ,,	68	10	0	July	1,322 ,, ,,	44	1	4
August ..	$1,174\frac{1}{2}$,, ,,	38	13	0	August ..	1,319 ,, ,,	43	19	4
September	1,219 ,, ,,	40	12	8	September	2,044 ,, ,,	68	2	8
October ..	$1,498\frac{1}{2}$,, $9\frac{1}{2}d.$	57	15	$11\frac{1}{2}$	October ..	1,451 ,, $9d.$	54	8	3
November	918 ,, $10d.$	38	5	0	November	1,514 ,, $10d.$	63	1	8
December ..	$2,022\frac{1}{2}$,, ,,	84	5	5	December	1,875 ,, ,,	78	2	6
	164 sold at home	6	16	8		182 sold at home	7	11	8
	5 cwt. cheese in summer ..	16	5	0		6 cwt. cheese in summer ..	21	0	0
	Butter sold ..	5	0	0		Butter sold ..	5	7	0
	788 estimated milk to produce cheese and butter.	..				$912\frac{3}{4}$ estimated milk to produce cheese and butter.	..		
Total ..	17,142 gallons.	£632	5	$11\frac{1}{2}$	Total ..	$19,591\frac{1}{4}$ gallons.	£725	6	10
Average per Cow ..	714 gallons.	£26	6	$10\frac{3}{4}$	Average per Cow ..	$725\frac{1}{2}$ gallons.	£26	17	$3\frac{1}{4}$

In comparing the above, which are certainly remarkable figures, with the cheese records of the First Prize Dairy Farm, it must be borne in mind that Mr. Miles's cows are renewed, to some extent, as a certain number of newly calved or calving cows are bought each autumn.

The horses—10 in number—comprise 3 mares and 1 horse for working the land, 1 nag for the milk-cart, 1 nag for sale, 1 nag-mare 5 years old, in foal to "Pero Gomez,"—a deep, roomy mare, which was purchased as a yearling for 11*l.*, and has proved a regular and valuable breeder; 1 boy's pony, rising 4, a cart filly foal, and 1 nag foal, a yearling nearly thoroughbred, out of the mare. Altogether a numerous lot, but not altogether unremunerative. The pig-stock comprises 4 Ingilt sows, 3 Tamworths, and 1 White breed and 2 feeding-sows.

Nothing is neglected at Tatenhill. The garden is neat and well kept, and every available spot, both in the fence and garden, is made to grow a fruit-tree.

At our second visit we were anxious to see what cultivation was adopted for roots, and how far a somewhat favourable spring had been utilised to clean the stubbles, some of which were rather wild. No. 6 field was planted with mangolds and potatoes after barley. The operations comprised one deep ploughing in autumn, turning back the furrows in spring, scuffling and working clean, ridging and manuring with Burton night-soil, 1 ton of Webbs' manure, and 5 cwt. salt. No. 11, the peat-field, which had only been recently drained, and was very dirty, had been well worked for swedes, and was in the way of being thoroughly cleaned. The farther side, which was drained in the winter, was planted with cabbages, which promised a good quantity of winter food. Three acres of swede turnips were the most successful crop in the neighbourhood, where the combined influence of drought and fly had proved most destructive, and these had been saved by an amount of attention indicative of a man accustomed to overcome difficulties. When it became evident that the enemy was not only at the gate, but had breached the walls, a boy was employed day after day drawing elder-boughs dipped in paraffin oil and water, up and down the ridges, fresh liquid being applied for each ridge. In this way the enemy was routed, and the result was a capital plant, which was ready for singling early in July; the rest of the field was sown with Yellow Tankard turnips, and the headlands would be planted with cabbages. Notwithstanding the dry weather, the pastures yielded abundance of grass, attributed by Mr. Miles to the fact that he does not turn out early and poach

his strong land, but allows the grass land to get a good face on it. All the corn-crops were most promising. Mangolds were forward, but gappy. Fences were neatly trimmed, and ditches brushed out. All the grass from such sources is given to the cows at milking time, and adds considerably to the food resources.

Labour on a dairy-farm is always a serious item, but here it is reduced to the minimum of necessary expenditure, owing to the important share of work done by the farmer and his wife. The hands comprise

Waggoner at 17*s.* 6*d.* a week. House free, coals carted, &c. 20*s.* to 30*s.* extra for harvest.
Cowman at 16*s.* Do. do.
Irishman at 14*s.* Extra money at harvest.
Boy hired by year at 6*l.* and food.

The wife, assisted by her step-daughter, 13 years of age, out of her school-hours, does all the house-work. Three men and the farmer milk, at 5 A.M. and 5 P.M. Calculating the value of the cottages, harvest-wages, and additional help at harvest at 25*l.*, and estimating the lad's food at 9*s.* a week, the total labour comes to about 180*l.*, equal to 1*l.* 8*s.* an acre. Harvest-work is done by 5 men, who tie and set up the corn at 6*s.* an acre, with an allowance of beer, besides helping to milk night and morning, and cutting roads round the fields for the reapers. The corn is cut by Picksley's Back-delivery Manual worked by the farmer, with a lad to drive the horses. Average work, 6 to 8 acres a day. The farmer stacks all the produce, which is placed on brick-staddles provided with means of ventilation, and very tidy work is made.

The outlay on purchased foods and manures is very much the same as labour, viz., 172*l.* 9*s.* in 1822, and 162*l.* 6*s.* 11*d.* in 1883.

The profitable character of the business may be gathered from the fact, that whilst the sales of produce in 1882, reached over 1400*l.*, the expenditure of all kinds was only 1097*l.* 3*s.* 5*d.* And in 1883 matters were still more promising, for whilst the sales realised 1395*l.*, the outlay was reduced to 1047*l.* 4*s.* 8*d.*, and this with an increasing stock. On January 1, 1884, a valuation was made by a neighbouring valuer, whose figures were as follows:—

	£	*s.*	*d.*
Cattle	987	0	0
Horses	403	0	0
Pigs	38	0	0
Corn in stacks	450	0	0
Hay, mangolds, turnips, &c. ..	650	0	0
Total	£2546	10	0

Assuming that these figures represent the working capital of the farm, and seeing the large amount for the last item, hay, &c.—which could hardly be realised—we should say it exceeds rather than that it is under the actual amount. It follows that the profits to cover interest of money, and the labour of the tenant and his wife, after expenses of every kind have been defrayed, including house and tradesmen's bills, have averaged 13 per cent. per annum. But the most extraordinary feature of this history, which is quite unique in our experience, is that this respectable capital has been entirely built up by the ability, energy, self-denial, and perseverance of the farmer and his excellent help-mate. With such facts, for which from the strictest investigation we can vouch, there is great encouragement for the small farming community.

Class 3.—Second Prize.

Mr. Sherratt, Oclepitchard, near Hereford.

	A.	R.	P.
Grass	66	1	30
Hops	16	1	17
Arable	47	3	26
	130	2	33

Mr. Sherratt, who occupies on yearly tenure, under J. H. Postlethwaite, Esq., Liverpool, came originally from Scotland, and has been the tenant of Oclepitchard for 28 years. He is not restricted as to cropping or sale, though holding under an agreement. The value of the farm has been much increased by the making of two hop-gardens, which are the leading feature and the chief source of profit. Before commencing work Mr. Sherratt studied the systems of management as practised in the county, and commenced soon after his occupation to plant part of a field, which yielded fairly well; and believing the business would answer, he finished his first field, and after a time commenced a second, which was only completed in 1883. As the land lies rather high and is somewhat exposed, Mr. Sherratt found that shelter from prevailing winds was necessary; he has paid great attention to the development of the hedges, which are now admirably adapted to break the force of the winds which might otherwise prove so destructive. The ordinary annual cultivation comprises three ploughings, three scufflings, three harrowings, and an equal number of rollings. At our second visit, on May 28th, we were disappointed to find the gardens in a dirty state, which was

stated to be unavoidable, owing to the late bad season. Dry weather, which had prevailed ever since the first week of April, had prevented the usual cultivation before the hops commenced to grow; after which it would be dangerous to touch the land until the bines are trained to the poles. Mr. Sherratt did not apprehend any difficulty on this score. The second ploughing was carried out in March. The last furrow is ploughed up to the hops, and then the hills are earthed up by men with mattocks.* The crop ranges from nothing up to 15 cwt. per acre, which latter produce has been twice reached in 25 years. An average yield is 8 cwt. The annual cost of labour is about 10*l.* an acre, made up as follows:—

	£	*s.*	*d.*
Cultivation as described	5	0	0
Setting up poles	0	12	0
Picking 560 bushels at $1\frac{1}{2}$*d.* ..	3	10	0
Pulling up and piling poles ..	0	18	0

About 1500 bines per acre. These are planted in two ways, either 8 feet between the rows, and 4 feet from hill to hill, in which case 3 poles are used to each hill; or 7 feet between the rows and $3\frac{1}{2}$ feet from hill to hill, using 2 poles to each hill: in both cases 4 plants in each hill. Farmyard-manure, either made on the farm, or purchased, is principally relied on; Mr. Sherratt does not much like woollen rags. The hops suffer considerably from aphis at times, but he has never washed the bines, and does not dress the poles with any preservative, so as to prolong their efficiency. Goldings and Mathon Whites are the sorts chiefly grown. The general character of the land at the Holdberry Farm is strong red clay. The buildings are suitable and comparatively new, the oast-houses and kilns for hop-curing very well arranged.

Mr. Sherratt began by keeping Hereford cattle, but gave them up on account of severe losses from quarter-evil. More than half the young stock died from this cause, which he attributed to the poverty and coldness of the pastures. He then introduced Ayrshires, which he found much hardier; and during the last twenty years has only had two cases of quarter-evil. The ordinary practice is to procure a few in-calf heifers every year from Ayrshire, and from these and his own stock he selects from ten to twelve heifer-calves, which are reared by hand. The bull calves, which usually form two-thirds of the produce, are either sold with their mothers, or fed for the butcher, and all

* Writing on July 5, Mr. Sherratt says, "I have now got a fine mould in my hopyards; they are clean and rowed up, and the hops in general over the tops of the poles, some of them a yard or two over them. Also some of the earlier sorts meet across the rows, and at present the appearance is most promising."

spare milk is made into butter. Mr. Sherratt has established a trade for milk cows, which are principally sold to gentlemen in the neighbourhood of Hereford. At the present time the cow-stock is considerably reduced, owing to the impossibility of getting the usual draft from Scotland, and the risk attending the introduction of cattle. Twice has the stock been attacked with foot-and-mouth disease, and each time the losses were equal to a year's rent. At our visit in January the total horned stock was 17, comprising 7 cows, 6 two-year-old heifers in-calf, 3 yearling heifers, and 1 calf.

About a score of Shropshire ewes are usually kept, the lambs being sold fat during summer, and the ewes later on. Now, owing to the scarcity of cattle, the ewe stock increased to 35 head, which produced 47 lambs. The land is too strong for a permanent flock; indeed, so great were the losses from liver-rot in 1879, that sheep were discontinued until 1883.

Six working mares are kept, and foals bred. This large force enables Mr. Sherratt to command working power at times when on such strong land it is all important. We saw a useful three-year-old, two-year-old, and yearling. Nag-breeding has been successfully practised, the foundation being an old mare by "Hereford," a son of "Sir Hercules," which has bred several winners, and herself was twice a winner at Royal Shows, but is now near her end; and a thoroughbred stallion, "Bravado," by "Buccaneer," dam "Woodbine," by "Stockwell," "Woodbine" out of "Honeysuckle," a sister of "Newminster," by "Touchstone," out of "Beeswing." "Bravado," 15 years old, is a dark brown, 16.1 hands, with plenty of bone, and well qualified to get good hunting stock. We saw out at grass a five-year-old mare by "Ladbrooke," with foal by "Bravado," entered for Shrewsbury—a promising pair; a dark chestnut four-year-old gelding, "Energy," by "Bravado," with great depth and powerful loin, and some youngsters that did credit to both parents. The total number of horses in January was 15. Several prizes have been taken by the nags, and good prices are made. The sons break them in—a pleasant occupation, which helps to make home attractive. Mr. Sherratt has a large family, ten in all, ranging from 9 to 25. One lad, with a decided turn for carpentry, made two very creditable carts in his spare time; and all are brought up to hard work, of which Mr. Sherratt sets an example. He himself commenced life as a ploughman in England, then became a bailiff, always saving money, until he was able to take a wife and a farm. I am sorry to add that Mrs. Sherratt is now a great invalid.

Pigs are kept to utilise the waste from the house and refuse from the dairy, and provide bacon for the family.

Hens and ducks are bred, and eggs sold.

The tillage land has not paid of late years. There are only five fields, which are cropped as follows:—

1. Cow grass and clover; grazed early, and mown either for hay or seed.
2. Wheat.
3. Roots.
4. Wheat.
5. Barley and seeds, with 2 cwt. of artificial manure per acre.

At our second visit in May we found No. 283, 10 a., below the house, in barley and cow-grass after wheat. A capital plant, even, thick, and promising. Young seeds coming well, and land clean. Mr. Sherratt adopts this cropping because the quality of the barley is so much better after wheat than it would be on roots. The wheat crop growing in fields Nos. 240 and 238 was also promising. The fallow, owing to the strong nature of the land and the absence of rain, was absorbing a vast amount of horse-power, and the chance of a crop appeared somewhat problematical; but owing to judicious management and auspicious rain, a good tilth was eventually secured. The swedes came away well, and there was every prospect of a crop. Accounts are accurately kept, Webb's system being used. The returns are governed mainly by the hop-crop. Thus in 1882 the crop was almost a failure, but the small total yield of 7 cwt. was sold at the rate of 21*l.* a cwt. In 1883 the yield was good, nearly 12 cwt. an acre, and the price, 7*l.* 10*s.*, gave a return of 891*l.* 7*s.*, equal to over 60*l.* an acre. In 1881, a crop of 5 cwt. per acre made 555*l.* In 1879 the crop was next door to a failure.

Servants Recommended for Certificates.

Edmund Jefferies. Unmarried, aged 27 years. Recommended by the Judges for clever management of the farm at Bolus Magna, where and elsewhere he has managed for his mother, Mrs. Ann Jefferies, for 13 years, as per particulars. See page 581.

Thomas Price, Huntington Court Farm, near Hereford. Aged 52 years, married; with 7 children, the youngest 14, all up and doing well. He was most strongly recommended by the late Mrs. Goodwin, and by Mr. Evans, who is one of the executors. He was in the late Mr. Goodwin's service for 30 years, and since Mr. Goodwin's illness has had the management of the Huntington Court Farm. Before that, Price was hind for 13 years on a

farm of Mr. Goodwin's at Leominster, and was recommended for ability, zeal, honesty, and excellent character. The Judges were favourably impressed with what they saw of his management under great difficulties (see p. 580).

Robert Silcock, Hill Farm, Stafford, was recommended by Mr. Holme. Aged 30, single. Three years' service. He takes great interest in stock, has good observation, always looks round first and last. He is sober and steady. His value and capacity were severely tested a year since, when Mr. Holme met with an accident in harvest, and was sent off for ten days to the Isle of Man. Everything was well managed in his absence at a critical time.

Henry James, Penkridge, near Stafford. Recommended by Mr. T. J. Griffin. He is fifty years old, is married, and has brought up a large family. He is a day labourer, with charge of machinery; he drives the engine, cuts fences, stacks, thatches, and can do all kinds of work—mending a clock, or a sewing machine, if required. Twenty years' service, he is faithful, honest, and temperate. Mr. Griffin says this man is deserving of everything that can be said in his favour.

William Edwardes, of Kenwick, near Ellesmere. Recommended by Mr. Miles Woodburn. Aged 40. He is married, with 6 children, ranging from 12 to 2. Edwardes has worked on the farm for 15 years, first as a labourer under Mr. Ryder, the former tenant, and latterly as Mr. Woodburn's hind, receiving 18*s.* a week. He understands all kinds of work, is reliable, steady, and is interested in his master's wellbeing.

James Dukes, of Sugwas, Hereford. Recommended by Mr. F. Hawkins, in whose service and his father's he has been since 1855. Age 65. He is married, and has brought up a family of 6 children under some difficulties. He is thoroughly trustworthy, has a good eye for stock and their ailments, and takes a great interest in his work.

I cannot conclude without expressing the high appreciation the Judges had of the kind and hospitable reception they met with from all the competitors, and the readiness evinced to answer questions and afford information. They will long remember their pleasant and instructive work in connection with the farm competition of 1884.

XIX.—*Some Observations on Parturition Fever in Ruminants; commonly recognised in Ewes by the terms "Heaving" or "Straining."* By Professor W. Robertson, Principal of the Royal Veterinary College.

The period and state of parturition offer particular facilities for the action and operation of many and varied morbid processes. This state is to some extent a special one, consequently the morbid actions are to a like extent unique.

The assemblage of rather complex phenomena known as "*Fever*," occurring at parturition, is probably special not so much as respects its intrinsic nature, as the condition of the animal in which it finds a locality for its operation. The fever attendant on parturition, to which attention is now directed, is essentially "*Fever*" in the pathological sense of the term. In thus restricting the term, there are excluded several diseased conditions occurring at this period of the animal's life probably wrongly designated "fever," such as Parturient Eclampsia, otherwise known as "Parturient Apoplexy," "Dropping after Calving" or "Milk Fever," and "Loin Fallen."

The disordered condition upon which it is proposed to offer some observations ought properly to be regarded as simply surgical fever of the septic form, somewhat specialised, because occurring at the period of parturition. The fever is essentially a continued fever, characterised by much disturbance, extensive but variously pronounced lesions, chiefly of organs in the pelvic region; and in the ewe, in particular, of frequent occurrence and great fatality. In this latter animal, also, it seems possessed of capabilities of propagation by mediate and immediate contact, which cannot be affirmed of it in the cow.

In studying this development of fever it will be useful, previous to entering upon it in detail, for us to keep in recollection certain facts and accepted deductions with reference to the production of septic conditions in all animals. The term "*septicæmia*," it ought to be remembered, is applied to two very different states or conditions. In one application it is employed to designate an empoisoned state of the blood, resulting from the entrance of animal matter, fluid generally, in a state of chemical change; or in others of organisms which, while they produce chemical materials of a deleterious character, are themselves innocuous, or at least the living tissues correct and modify their action. This form is usually recognised by the term *septic poisoning*. This manifestation of hæmal disturbance, the common accompaniment of wounds of an ordinary character, has no

development, so to speak. It is only likely to prove fatal when the amount of the poison entering the body is excessive, or when there occurs a repetition of its reception. The usual course or termination of this received material is for it to be neutralised in the blood-stream.

In the other sense the term is employed to convey a very different meaning; not one referring to intensity or amount, but one of essential quality. Here this *septic infection*, as the process is called in contradistinction to *septic poisoning*, does not depend for virulence upon the amount of the material—whether changed animal products or something else—but upon its inherent power of self-augmentation in the animal body in which it is implanted. The medium of introduction may be decomposing animal fluid, but in addition it must contain *micro-organisms* able to reproduce and propagate themselves, and by changes which they induce in the animal tissues give rise to conditions which become rapidly fatal.

Further, to the condition of inoculation with putrid, otherwise septic matter, and the production throughout the different organs of the body of multiple abscesses, the term *pyæmia* has been given. The irritation which, acting upon the tissues, ends in the production of these abscesses, is always associated with micro-organisms. This formation of abscesses may be looked upon as developed *septic infection:* it has no connection with septic poisoning. So we require to remember that there is *Septicæmia* and *Septicæmia.* The fact of the existence of *micro-organisms* in one form at least of septicæmia and in every one of pyæmia seems to be allowed. It seems that the *bacterium* of pyæmia does not propagate largely in the circulating blood as in the infective form of septicæmia, but becomes fixed at certain points, and from these propagates. It is even uncertain whether it is always the same *bacterium* which is associated with pyæmia.

In carefully gathering up all information pertaining to this subject of "parturition fever" of cows and ewes, I am disposed to regard it as obviously presenting itself for our notice in two very distinct manifestations which are probably often confounded.

1. There is the fever resulting from what may be designated *septicæmic poisoning*, the result of the entrance into the circulation of putrid animal matter from intrinsic or extrinsic sources; not capable of self-augmentation, and disposed to exhaust itself in the animal body. 2. The more serious form, in which the fever results from what at present is termed *septicæmic infection*, in which the received material may be the result of putrefactive changes or not, but which must have added to it the specific micro-organism; it is also self-augmentative.

In cows it is probably the former manifestation which is

most commonly encountered, on which account it is more amenable to treatment, and less disposed to propagate. In ewes, on the contrary, although the less serious kind is met with, I feel certain that the truly infective form is that which more frequently demands attention. The great fatality, undoubted resistance to treatment, and tendency to spread or appear as an enzoöty or epizoöty, are more satisfactorily accounted for on the assumption of the power of self-augmentation possessed by the virus.

In both forms the structures and organs which are chiefly the seat of the diagnostic lesions are nearly similar. These are chiefly those situated in the pelvic cavity, the uterus, and its appendages, with the investing peritoneal and connective tissue structures.

Causation.—Undoubtedly the great determining influence in the production of both forms of the fever now under review is the parturient state, in which, from a combination of influences, general and local, the susceptibility of the animal to adverse influences, and particularly to both septic poisoning and septic infection, is largely augmented as compared with that of non-parturient animals. In many instances, particularly in the cow, in which, as already noticed, the more manageable form of septic poisoning is more frequently experienced, we seem not to require to travel far for an explanation of the disturbed condition. The power of changed and putrefying animal tissues and fluids to produce this hæmal contamination being granted, we find that there exists in many animals putrefying and septic matter, together with facilities for its absorption. The former may be found in a dead fœtus, in placental membranes, and uterine fluids, retained in whole or in part, and undergoing decomposition. While from injuries sustained in effecting delivery by mechanical means, accidents occurring to the parturient passages, as inversion with rough handling in replacement, we observe wounds or abrasions which offer a free access to the injurious fluids; while we must not forget that in great numbers of instances these facilities of open surfaces for absorption occur without our being aware of their existence. Probably these latter are frequently the cases where exposure or fatigue, or both conjoined, have been accredited with the production of this manifestation of the fever. No doubt cases of the fever may be encountered in cows where none of these agencies seem to have had a chance of operation, or at least where their position as the true inducing cause cannot be substantiated.

Amongst sheep the appearance of this fever would not unfrequently seem to develop characters of an occult and mysterious

nature, such as are commonly spoken of as epizoötic, when, by more careful examination, it may be found that the true cause of its extensive dissemination is contact, directly or indirectly, with organic matter in a state of change. With this latter class of stock I am inclined to regard the greater number of cases of parturition fever, particularly such as appear amongst large numbers of animals at the same time, as owing their existence only to contamination of the system with some agent which, when placed in favourable conditions in the animal body, is capable of self-augmentation, and of inducing the tissue changes so characteristic of the state of septic infection. For the production of this morbid condition there appear to be necessary at the period of parturition two conditions.

1. A certain state, particularly of the parturient passages, in which a wound or fresh abrasion of the protecting membrane exists, it being rare that inoculation occurs while the membrane is intact, or even where a wound exists if granulation is rapidly progressing. The chances of inoculation are certainly greatly increased with abrasion.

2. The existence of an active disease-inducing agent—most probably a *bacterium*—capable of self-augmentation.

Regarding the first condition, those who are conversant with the act of parturition in the lower animals know well enough that wounds or abrasions are lesions of common occurrence. These occur less commonly in connection with the uterine tissues than with those more external, viz., the vagina and labiæ. When instruments have been employed, or much manual interference has been needful, it is exceedingly difficult to avoid the infliction of these, and trifling ones only are needed. Also, in the cow, the removal by the hand of adhering placental membranes gives the same opportunity of auto-infection—the chief mode of contamination in her. In the vagina and on the labiæ wounds and abrasions freshly made are of more common occurrence, and from these there is no doubt that inoculation frequently takes place. I am aware that, by many, external infection is said to play a rather unimportant part in the induction of the parturition fever of our patients. To this conclusion I am disposed to demur. Although the form of fever in the cow is chiefly that of septic poisoning, the result of self-contamination by absorption of putrid materials, so largely found connected with animals at the period of parturition, there are yet recorded well-marked cases of the infective form, the result of inoculation by material brought to the genital organs, on which were wounds or abrasions, by the use in the act of parturiton of articles or instruments previously employed on animals suffering from this fever, or which were contaminated with unwholesome animal

discharges. Some have even gone to the extent of charging the proximity of decomposing animal matter with the production of the fever in this animal. This mode of production, however,—inoculation through the agency of a poison-laden atmosphere—is generally regarded as a much rarer occurrence than the agency of auto-infection.

While admitting, in the case of the cow, the frequency, or rather constancy, of the inducing agent of parturition fever as situated in the animal itself, in the ewe I am disposed to look more largely to factors operating from without. As the fever is here of a different type, so does it appear that the agents which produce it are different. In the more artificial and carefully tended breeds, which are the greatest sufferers, a great amount—probably too much—of manual interference is exercised by those in charge during the act of parturition. When we take into consideration that the ordinary attendants on a flock at the period of lambing have frequently to undertake the after-death examination of animals which have succumbed from many diseased conditions, and that in the matter of cleanliness they are not the most scrupulous, it requires no great stretch of imagination to understand how septic material may be conveyed by the hands into the parturient passages of ewes which have been hitherto healthy. These attendants I have observed passing from the handling and disembowelling of carcasses in which inflammatory and putrefactive action, it may be of this very character of which we are now speaking, was conspicuous, having merely wiped their hands on a dirty cloth or a little grass or straw, to manipulatory interference in the delivery of an apparently healthy animal. As confirmatory of this mode of propagation in several outbreaks of this fever, I have observed that all precautionary measures adopted failed to arrest the spread of the malady until a change of attendants had been adopted and rigidly carried out. In addition to this direct conveyance of contamination by the hands and clothes of infected attendants, who may have been in contact with similarly diseased animals, or with septic carcasses, or with various organic materials undergoing putrefactive changes, there seems a strong presumption that a like infection may originate from sources less appreciable. It seems probable that parturient fever of the septic infectious type may originate from decomposition, or change of various animal substances unconnected with such animals as are actually suffering from this disease. On this account there is danger in placing animals in parturition in situations where contact may be effected directly or indirectly with discharges and secretions from certain sores or wounds of living animals, or even with dead, separated, and putrefying animal tissues.

To summarise as respects the reputed causes of "*parturient fever*" in the cow and in the ewe, I am disposed to attribute the occurrence of the simple or more benign form, that which is most frequently seen in the cow, to the passage into the circulation of decomposing or putrid animal fluids which do not necessarily contain micro-organisms; or, if such exist, not possessing the power of indefinite production. I hold that the general disturbance is brought about by the action of chemical changes in the fluids and solids of the body, rather than by micro-organic activity. Also that, other things considered, the severity of the fever is in direct ratio to the amount of the disturbing element received; while in all instances there is a disposition in the living tissues to overcome the evil tendencies of the received material. This form as a septic condition is at present known as "*septicæmic poisoning.*"

In the other forms, the more serious disturbance occasionally seen in the cow, more frequently in the ewe, the condition appears to follow as the result of the entrance into the system of *pathogenic bacteria*, *i.e.* disease-producing organisms—these organisms probably not being special, but capable of self-augmentation, and in many instances tending to further local changes of a specific character. This form does not appear to depend for its virulence or severity upon the amount of virus imported, but upon its character or quality. It is recognised pathologically as "*septicæmic infection,*" and is capable, through reception of the smallest amount of the infecting material, of propagation in other living animal bodies.

Anatomical Characters.—In all instances of a fatal character, the local lesions may be broadly stated as specially located in the pelvic organs. When the contaminating material absorbed has been considerable, and the result has been rapidly fatal, preceded by much fever, in acute cases of "*septic poisoning,*"—local lesions may not be the most marked feature. The blood as a whole is physically altered, is darker in colour, coagulating imperfectly, with evidences of hyperæmia or capillary hæmorrhage. The blood markings are chiefly found beneath the serous membranes of the pericardium, endocardium, and the pleuræ, while the hyperæmia is chiefly distributed in connection with the mucous membrane of the intestinal canal. When *septic infection* has existed, we have in addition evidences of a general infective condition of the different tissues and organs of the body. Putrefactive changes are early established, the different tissues are largely infiltrated with gases, and are of varying hues of purple and metallic green, soft and pulpy. When the lining membrane—*endo-metritis*—of the uterus is chiefly affected, the peritoneum is less involved. In many instances where the

infective character of the process is well established, the vagina will exhibit variously disposed ecchymoses and patches of blood extravasation, with certain ill-conditioned sores scattered over the membrane extending to the labiæ, with occasionally croupous exudations; the whole being much swollen from infiltration into the submucous tissue. Within the uterus itself there is usually a greater or less amount of dirty grey, or brown coloured grumous fluid, composed of effused blood, secretion from the membrane, broken up fœtal membranes, and various cell growths, all in a state of decomposition, and emitting an offensive smell. The viscus is never contracted as in a healthy condition. The walls are thickened, soft, heightened in colour, and largely infiltrated with the usual inflammatory products. The lining membrane is of itself thickened, and is of an uniform dark colour, with darker patches from blood clots and extravasations; these darker markings, and more advanced changes, are particularly noticeable in the vicinity and around the cotyledons, which of themselves seem deeply infiltrated, and of a greyish tint, from the greater amount of purulent material connected with them. Many of these latter appear as if undergoing separation from their uterine attachment, and when manipulated feel extremely friable, and liable to be detached.

Beside these changes in the mucous membrane, it will be found that the submucous and connective and muscular structures have undergone changes of a destructive character. These are swollen from inflammatory infiltration; the products of which are also in their turn undergoing putrefactive changes, this infiltration and these changes extending into the subserous or peritoneal covering—*metro-peritonitis*. When the serous covering is much involved, we find fluid of varying character and quantity in the abdominal cavity. This fluid is rarely of an uniform character or consistence, usually coloured, having floating in it shreds of ill-formed, unhealthy-looking lymph. Occasionally this lymph may form adhesions extending from the uterine surface to some of the adjacent structures. While, in addition to such adhesions, the diseased process may have invaded contiguous textures and organs within the pelvic basin —*para-metritis*—amongst which putrefactive and other changes have taken place. This extension of the morbid process to the several structures in the pelvic basin is the usual feature of that terribly fatal form of parturition fever in the ewe which has such a close relation in many of its features to the parturient fever of the human female. The extension of the inflammatory and other morbid products, where such is observed, may in part be accounted for from the contiguity and similarity of structures or organs, in this way passing anteriorly to the diaphragm and

pleuræ; but I imagine that the explanation of such extension is equally, if not more correctly, afforded by regarding it as owing to the state of general septic infection. In some instances in the sheep I have observed *thrombosis*, *i.e.* plugging of the pelvic veins, well-marked pneumonia, with plugging of pulmonary vessels and minute abscesses scattered throughout the pulmonary tissue, which are pathological conditions in all probability owing their origin to irritative changes connected with bacterial growth and dissemination. In many of the very rapidly fatal cases of parturition fever resulting from a combination of septic poisoning and septic infection, we have no *thrombosis* of uterine or pelvic vessels, but very obvious changes in the physical characters of the blood, already noticed as being features of the common form of septicæmic poisoning appearing in cows.

Symptoms.—The period which may intervene between the accomplishment of the parturient act and the accession of the attendant fever is somewhat varied. In the ewe this period is not so long delayed as in the cow, although even in the latter case a week may elapse before we can be satisfied of the existence of indications of illness; this is particularly the case when the morbid state seems to result from the decomposition of retained placental membranes or other materials. From the accomplishment of the act of birth-giving, until the outset of the illness, the animal may, even to an acute observer, seem to be progressing favourably. The earliest indications of change are rigors, staring coat, elevated internal temperature, irregular distribution of surface heat, suspension of milk secretion, with a flaccid condition of the udder, irregular appetite, and other visible signs of fever. More careful examination will reveal disturbance in connection with other activities and functions, and show that there exists a decided change in the relation of the animal's situation and exchanges with the outer world. The pulse is increased in frequency, is small and wiry, the respirations are short and hurried, the secretions from the kidneys and the bowels are scanty, and the latter dry. In some animals, in which the uterus or the bowels seem much involved, we have exhibitions of pains, with febrile exacerbations and some restlessness. Except in the very mildest cases, the arrest of milk-secretion and impairment of appetite are always marked features which maintain their ascendency all through the disease. Should this condition be connected with injuries to the generative passages received during parturition, there will be much tumefaction of these parts, with sometimes a discharge of a slightly coloured serous fluid; while if a manual examination of the passages is made, the elevation of internal temperature is very perceptible, and in rarer instances we may detect an

exudation of a crouprous character over certain of the abraded surfaces.

It has been stated by some observers that, where *metro-peritonitis* exists, there is invariably an effusion of fluid into the peritoneal sac, and that this condition is diagnosticated by distension of the abdomen so obvious as not to escape detection. Now, although this condition is rarely absent, I am not satisfied, save in exceptional instances, that the accumulation of fluid is such as to force itself upon our attention. In the greater number, however, if there is not obvious distension, there is tenderness on pressure.

Course, &c.—In the cow, the usual course of the fever of the *septicæmic* infective type is short and fatal,—a few days, or not more than a week, being sufficient to carry the animal through all the stages of established fever and general blood-contamination, to a fatal termination. Other manifestations of the fever—the *septicæmic poisonous* manifestations, where the truly infective character seems absent,—rarely reach the same height of febrile disturbance, the living tissues being able to resist the action of the absorbed material, or annul its virulent properties. These symptoms, after a few days of violent general disturbance, suffer decline, and enter upon a course of steady convalescence. A few of the same class, after the subsidence of the more active and distressing symptoms, show so far a recovery, which is arrested at a certain point, and a condition of chronic disease of both uterus and vagina is established, evidenced by a persistent form of *leucorrhœa.* In many of these cases of chronic catarrh of the genital passages following parturition fever, I have observed that retention of uterine membranes has been a prominent feature, and that these are, with an extra amount of variously constituted fluids, discharged at irregular intervals in irregular quantities. While, if no membranes have been retained by a partly contracted uterus during inflammatory action, imprisoned secretions may have a similar action, these only finding exit at uncertain intervals, and when their amount has distended the viscus, and forced a passage through the partially closed natural opening.

In the ewe the fever, as previously stated, is almost invariably of a more severe and malignant type, a true *septicæmic infection*, apparently capable of propagation mediately and immediately, and, when once established, seldom failing to pass on to a fatal termination. When declaring itself close upon the birth of the lamb, it is less likely to be complicated with other affections, and is seen in its purest and most severe form. Those cases which are somewhat delayed in their appearance are frequently mixed with inflammatory affections of the udder, and if not imme-

diately fatal, become so through complications. In addition to the ordinary symptoms of fever already spoken of, the ewe is found resting apart from others, no attention is paid to the lamb, for which she has no milk. When raised, and caused to move, we find much listlessness, hanging of the head, the ears dropped, with a little frothy saliva collected around the angles of the mouth. The back is arched, and the limbs, particularly the hind ones, are moved with difficulty, this latter symptom being most marked when the fever is associated with inflammation of the udder. Very shortly following the appearance of these symptoms we may observe the discharge, with straining, of a coffee-coloured fluid from the vagina, the lips of which are coloured and swollen, this straining being attended with grinding of the teeth, and other evidences of abdominal pain. Severe pulmonary and cerebral disturbances exhibits themselves in laboured breathing and impairment of consciousness, or want of control over the organs of locomotion. When the udder is much affected, inflammatory action of an erysipelatous character extends along the abdominal walls. Should the animal not immediately succumb to the complicated disturbance, portions of the gland-structure and fibrous membranes may detach themselves by sloughing. A fatal termination is frequently preceded by irritability of the bowels, passing on to severe diarrhœa.

Rarely in the ewe have we other termination to this fever than a rapid recovery or death. When a favourable termination is being reached, the first indications of the subsidence of the diseased action are the decrease of the hitherto high temperature, and a return to a somewhat natural state of the bowels. The discharge from the genital passages, which, if existing, may previously have been of a serous character, mingled with a certain amount of changed blood elements, is now less watery, and shows purulent or muco-purulent characters, while the external parts, although swollen, are less tender on being handled. When the temperature steadily maintains its unnatural elevation, or seems rather disposed to rise, with an extension of the swelling of an œdematous character to the hinder parts contiguous to the pelvic opening, on the membranes of which, both external and internal, are to be observed marks of blood extravasation; and when prostration becomes more marked, and a haggard expression is stamped on the countenance, with a discharge from the passages of a dirty, thin, ichorous, badly-smelling fluid, no appetite being present, and in some cases a certain amount of stupor develops, a fatal termination may be expected.

Treatment.—This may be regarded as resolving itself into two sections. 1. The adoption of such measures with partu-

rient animals as are likely to prevent the occurrence of either form of the fever, *septic poisoning*, or *septic infection.* 2. In the case of the actually suffering, by the employment of such agents and appliances, medicinal or otherwise, as seem best calculated to overcome the noxious material received, or to neutralise its effects.

1. *With respect to the prevention of the fever in any of its manifestations.*—If it be at all true that a chief factor in the induction of the contamination is the existence of wounds or abrasions on the uterine, vaginal, or vulvar membranes, it will be abundantly clear that the attention of all engaged in rendering assistance in labour cases ought to be directed to prevent the occurrence of injuries to these parts. Should wounds or abrasions have been sustained during the act of parturition, as soon as this has been accomplished, and before disintegrative and putrefactive changes have been entered upon, we ought, by the application of such antiseptic and disinfecting agents as carbolic acid, salicylic acid, permanganate of potash, or chloride of zinc, to operate as powerfully as we may be able in the direction of preventing the absorption of hurtful agents. When certain of the existence of vaginal wounds or injuries in other portions of the parturient passages, the proper treatment is to wash out the passages with tepid water, followed by syringing them with $2\frac{1}{2}$ per cent. carbolic acid, or chloride of zinc solution, or double this strength of permanganate of potash solution; after which to anoint the parts with carbolised oil, or, if much lacerated, to touch them with nitrate of silver or a strong solution of chloride of zinc.

The carbolic acid solution is best prepared by mixing one part of pure acid with four or five of glycerine previous to the addition of the water. The syringing with the antiseptics should be carried out daily for some days, and the anointing with the oil should follow each washing. If objection be made to the syringing, the fluid secretions ought to be removed as thoroughly as possible with a sponge, and the actually torn or abraded parts anointed with carbolised oil. For these purposes a mixture of one part of acid to twenty of olive oil is sufficiently strong.

No attendant on animals ought to give assistance in parturition if he has lately been handling or been in contact with carcasses, particularly if the animals have succumbed from any putrefactive or septic disease; nor if he has been handling decomposing animal matter, even should he cleanse himself as thoroughly as he may be able. Nor should any instrument which has been employed in contact with like material be used in delivering healthy animals until it has been perfectly cleansed

and disinfected, and a sufficient time has elapsed since it has been so treated. Articles which cannot be thoroughly cleansed, such as cords or absorbent structures, must on no account be used, however much they may have been washed.

With ewes, particular care ought always to be exercised that the individual who is actually affording assistance in lambing should not be required to make any examinations of carcasses, or to handle those, particularly of sheep which have died under doubtful conditions. In all cases where much manual interference has been necessary to effect delivery, the shepherd will do well to thoroughly disinfect his hands and arms with the wash previously mentioned, before proceeding to give assistance to other animals. While with all animals, chiefly with such as are herded in flocks, we must be careful, should parturition fever declare itself, that the diseased be removed from amongst the healthy as soon as we are satisfied of illness. In many instances it will be advisable to change the attendants, and to sprinkle, by means of a watering pot, the fleeces of the unaffected with the carbolic acid solution already mentioned, and remove them to a different and as yet uncontaminated situation, where both exposure and food-supply may be altered if desired.

I am well aware of the extreme difficulty there is always encountered, not merely in convincing stock-owners and attendants of the necessity of such extreme precautions, but even in having these fully carried out. Still I am satisfied that without such precautions every other measure will prove abortive. Indeed, so tenacious of vitality does the septic principle or agent of inoculation seem, that situations and paddocks where some forms of parturition fever have appeared one year, may, unless special cleanliness and care have been exercised, again be visited with a similar outbreak when parturient animals are placed there.

When ewes are confined to stationary paddocks during the period of lambing, every care ought to be exercised in the removal and burial, or destruction, of all placental membranes and other animal matter capable of undergoing putrefactive changes. The difficulty of carrying out these precautions to the full has led in most large flocks to the separation of the animals during parturition into sections, with a regular system of change—often at some inconvenience as respects the situation where the ewes shall be placed at the time of lambing—and the selection of temporary paddocks in the open field, and away from the common homestead.

I feel tolerably certain that in all cases of extensively distributed and virulent outbreaks of this fever amongst ewes, it is

the non-recognition of its truly septic infectious character, its capability of origin both from auto-infection and from extrinsic agents connected with putrefactive changes in animal matter, that so much difficulty is ordinarily encountered in combating its ravages.

So long as such influences as purely meteorological or dietetic conditions are chiefly regarded as the inducing agencies, so long shall we wander aimlessly in our efforts to prevent its occurrence, or fail in attempts to arrest its progress when fairly established.

2. *Management of the actually Diseased.*—Parturient fever, although occasionally assuming a lingering form, is usually a condition of much activity and virulence, while in no case can we approximately determine which cases shall be delayed in progress. Any treatment, therefore, which may be determined upon requires to be carried out energetically. As the probabilities are great that the entrance of deleterious matter has occurred through wounds of the parturient passages, we ought at once to direct our attention to the condition of these, in order to control or minimise, as far as we are able, the amount of poisonous material passed in this way into the system. We know that a moderate amount of putrid and unwholesome matter may, by the inherent strength of the system, be neutralised, or eliminated from the body, and the damaging effects of its introduction overcome; but if regular accessions of such matter are kept steadily passing into the blood, the vital energy and power of neutralisation are certain to be destroyed, and *septicæmic poisoning* to ensue.

That the steady supply of poisonous material and its entrance into the circulation are always favoured by the local tissue-changes and putrefaction which take place in connection with these lesions, seems highly probable; while from experimentation we are led to believe that the local and general use of certain agents delays or arrests the progress of these tissue-changes, as well as retards the absorption of puriform matters.

If such antiseptic agents as have already been mentioned have not been employed as preventives, their use as local curative agents is now indicated. These may be employed somewhat as already indicated, both as materials for vagino-uterine injections, and in proportions rather larger as ointments or liniments. Besides the local use of these agents, I have in several instances believed that good has resulted from their employment internally, and alternated with sulphite or hypo-sulphite of soda. Of these antiseptics the best for internal use are carbolic or salicylic acid. The former may be employed in doses of from thirty minims to one drachm, in water and glycerine, the latter of from

half a drachm to two drachms in solution of acetate of ammonia, according to the size or variety of the animal, every four or six hours. Should the bowels seem disposed to be confined, as they sometimes are in the cow, it will be needful to administer some laxative. The soda salts will have this tendency, and, with this end in view, their quantity may be increased, particularly if the animal continues to survive for some days, and does not utterly refuse to take food. Should strength give indications of failing, support ought to be afforded through means of nutritious liquid food, as good gruel, beef-tea, or milk combined with stimulants.

The application of cold water to the surface of the body, with the view of reducing the elevated temperature, I have tried rather extensively with sheep, but have not satisfied myself that its employment is deserving of general adoption. Certainly in some individual cases good appeared to result from its use, but not to a greater extent than with some other modes of treatment. When the general temperature continues high, and other features of pyrexia are marked, full doses of salicylic acid in solution, of acetate of ammonia, or ordinary saline febrifuges, with a moderate amount of some alcoholic stimulant, are well deserving of a fair trial. In such cases, during the very early stages of the fever, the careful use of aconite will often prove of advantage; its employment is, however, chiefly to be advocated in the first stage, while its continuance is never unattended with danger from its influence in depressing the action of the heart beyond the power of establishing reaction. In the ewe, when diarrhœa is associated with exhaustion and straining, I have obtained good results by combining the alcoholic stimulants with tincture of opium. The quantity of stimulants with opium which may be given to ewes in this condition is wonderful, from ten to twenty ounces of whisky or brandy, with one-third of the amount of laudanum, may be received, not only with impunity, but with obvious benefit, when distributed over a period of twenty-four hours. The latter medicine is also valuable for dropping into the vagina and uterus after these have been syringed with disinfectants, or even along with them. In the cow, when abdominal pain is a prominent feature, advantage may be taken of the soothing influence of hot water, employed by means of woollen rugs wrapped around the body, followed by the use of such stimulating and revulsive agents as mustard and turpentine. In both animals, should the fever not destroy during its early stages, and diarrhœa not exist as a troublesome symptom, the cautious employment of saline laxatives, with a liberal use of treacle, is to be recommended as likely to benefit by the removal of waste and dangerous materials

which otherwise would be retained within the system. Excessive or indiscriminate purgation is, however, to be scrupulously avoided; while, for all cases receiving treatment, shelter, with clean and comfortable location, must be provided.

These, or any other remedial measures which may be adopted, are more likely with the cow to be attended with beneficial results, from the greater frequency in her of that form of the fever—*septicæmic poisoning*—and its greater susceptibility to being successfully treated. In the ewe the amount of success, if not so great, is always sufficient to compensate for the trouble.

Amongst these latter animals our chief dependence must always be upon endeavours directed by common sense and the teachings of experience and experiment, with the view of preventing the occurrence of the fatal *septicæmic infection*, or of restricting its ravages should such appear.

XX.—*Report on the Exhibition of Live-Stock at Shrewsbury.* By Jabez Turner, of Horsington, Horncastle, Senior Steward.

Following "antient custom," it has become the duty of the Senior Stewards to submit a short Report of the proceedings in their respective departments, in addition, or as a sort of preface, to the more elaborate statement of the Official Reporters. As the history of the Show of live-stock for the year is in the hands of one who may fairly be termed "an expert" in all sorts and conditions of cattle, the few remarks I shall make must apply to the general character of the Exhibition, and I willingly leave detail to the abler pen of Mr. Housman.

The place selected for the Show closely adjoins what was so well designated by the President on his inauguration as "the ancient and picturesque town of Shrewsbury," where the Country Meeting of the Society was held in the year 1845, when the gentleman who this year so worthily filled the Presidential Chair was one of those who superintended the arrangements. He must have noted a great change from the Show of that period to the magnitude of the present Exhibition. The Showground, most conveniently situate on the racecourse, was not remarkable for rural beauty, but the surroundings were of an eminently picturesque character, the grand Shropshire hills forming an imposing background on all sides. It must be mentioned with gratification, that the arrangements of the Local Committee, and of their indefatigable Secretaries, Mr. Peele and Mr.

Bowen-Jones, were of such a nature as to give the amplest satisfaction to the officials and exhibitors, everything being done which was "in the bond," and in some instances the requirements of the Society being exceeded. The Railway Company also managed the transit of implements and stock to and from the Showyard in a manner which left nothing to be desired.

The Implement Yard Show, as usual, was opened on Saturday. It appeared somewhat crowded with exhibits, the number of feet occupied being nearly equal to that taken up at York. Many visitors took advantage of the comparative quiet of the day to study the continual advance and improvement in agricultural machinery.

For some years it has been usual to hold Divine Service on the Showyard Sunday in the Society's tent, for the benefit of shepherds, and other attendants on live-stock. This laudable custom was fully carried out, service being conducted by the Vicar of the parish; and an impressive and eloquent sermon preached by the Bishop of the diocese was attentively listened to by a full congregation, which included several ladies, the President, and many Members of Council and officials.

Precisely at nine o'clock on Monday morning, the Steward of General Arrangements introduced the several sets of Judges to their respective Stewards, and dismissed them to their labours. The weather, although somewhat threatening, continued fair, and the distribution and publication of the awards was soon in full swing, the stand being surrounded by members of what might well be called "the press," eager for early information as to the different prizes. On Tuesday, and during the week, the town presented a very festive appearance, the narrow and frequently hilly streets, the quaint old gables and generally highly decorated style of architecture, lending themselves admirably to the kinds of ornamentation adopted; and it may be stated without doubt that those who were privileged to view the torch-light procession of boats on the Severn, the play of different-coloured lights on the splendid lime-trees in the "Quarry," and the general effect of the illuminations in the town on the evenings of Tuesday and Wednesday, witnessed scenes of such a character as cannot be surpassed by any other town in England. The weather continued propitious during the whole of the Show, occasional showers cooling the ground, and rendering locomotion more pleasant and less fatiguing. The Mayor of Shrewsbury entertained the President and Council on Tuesday evening, when the representatives of many time-honoured names of "proud Salopia" were present at the banquet in the spacious Music Hall.

With regard to the proceedings in the Showground, it must

suffice to state that considerable interest was evinced in the results of the Farm Prize Competition, and much gratification expressed when the awards became known. The unusual number of 20 entries in the two first classes seems to indicate that the wave of agricultural depression has not been so severely felt in the West of England as in East Anglia and the Midlands. As the Report on this Competition is from the experienced hand of Professor Coleman, a very interesting record may be looked for.

Of the show of Live-stock it may be generally stated that thoroughbred and nag horses were weak in number and, with few exceptions, in quality. In stallions, Lord Bradford's "Chippendale" was far ahead of his competitors, and received the first prize, although doubts were expressed as to the benefit of giving the prizes of the Society to animals which, by reason of the high covering fee demanded, are not likely to be used by tenant-farmers; and it seems desirable that some arrangement should be made by which the services of a prize-taking stallion should be placed at the disposal of a certain number of members at a price not altogether prohibitory. I venture to suggest that in the Classes for Mares and Foals much difficulty would be avoided by giving a prize to the "best foal in the Class," leaving the mare to stand upon her own merits. In the Hackney Classes, Mr. John Robinson was successful with "Lady Cremorne," "Princess," and "Lady Shrewsbury," these animals being fine examples of natural advantages and superior training. In the Cart-horse Classes some noble specimens were shown, notably Lord Ellesmere's "Esquire," "Bismarck," and "King Charming," the latter taking the champion prize in the three Classes of 53 entries.

Nothing specially noticeable appeared in the Classes for Shorthorn Bulls, which did not appear to be equal to those seen at former Shows. The champion of last year, "Self-Esteem 2nd," took first in his Class, but has not improved in masculine character in the interim. The Female Classes, although not great in number of entries, were of much better quality than the Bulls. The "family groups" were interesting, showing the impress of the sire in various instances.

The Herefords mustered grandly, and were evidently "at home," no less than 144 of these favourites of the West being shown, many very superior in style, character, and weight. Devons, Sussex, and other breeds of cattle were represented about as usual. One good Longhorn appeared, and to those who are fond of searching for hidden beauty, the other specimens shown presented fine fields for investigation. It must be remarked that no less than 100*l.* was offered in prize money for

this breed, which had only 14 entries. The show of Channel Islanders was as usual very considerable, and their parade presented an agreeable feature in the programme for each day.

In the Classes for Long-woolled Sheep entries were about equal to former years, and their quality variable. Cotswolds made a smaller show than usual, the East Anglian flocks being unrepresented. Lincolns had some good rams, and four pens of excellent shearling ewes. In the Short-woolled Classes the Oxfordshire Downs, shown by Mr. Treadwell, attracted much attention, being fine level sheep.

It must now be recorded that the great feature of the Shrewsbury Meeting, in which it stands pre-eminently forth beyond any previous exhibition, was that of "Shropshire" sheep, no less than 853 head of this breed were entered, and not many of the 246 entries were absent. This number is unprecedented, and Shropshire agriculturists must be congratulated on having so well sustained the character claimed for their particular variety. The great Class of the Show, that for Shearling Rams, had 100 entries, and the difficulties of the Judges may be well imagined. It is, however, satisfactory to note that in most instances the decisions in these remarkable classes were endorsed by such of the public as are practically acquainted with the points necessary to constitute a perfect Shropshire. It was very generally remarked that the five shearling rams belonging to Lord Chesham, which took the first prize in their class, was the most valuable pen of sheep ever exhibited. The Southdowns shown seemed to the superficial observer of a somewhat larger type than usually appear at the Royal. Of the Mountain Sheep it must be noted that the Clun Forest variety were objected to as not being mountaineers, but the Stewards did not see their way to disqualify them.

Of the show of Pigs it might be stated, as is said to have been remarked by a gentleman recapitulating the woes of his afflicted country, that "it swarmed with absentees," a considerable proportion of the pens being empty. There was a fair entry of Berkshires, and in the Small Whites the entries by Lord Moreton were noticeable for fine forms and level feeding. Mr. Mander Allender sent his Tamworth "St. Lubbock," of which it was remarked that he had slightly improved in everything but temper.

As to the other exhibitions in the Showground, the opinion was freely expressed that the competition in Butter and Cheese should receive more encouragement and development by the Society; and although there appear to be difficulties, especially with regard to butter, yet it is possible that they may be surmounted, and it is certain that so important a branch of agri-

culture as the preparation of high-class dairy products should not lose the fostering hand of the Society.

The Working Dairy attracted many visitors, and the lectures given and illustrated daily were very successful, but an accident to one of the attendants caused the officials much anxiety. It is, however, satisfactory to know that the injuries sustained by the unfortunate girl are not of so serious a nature as was at first anticipated.

The number of visitors to the Showground was very considerable, especially on Thursday, when nearly 50,000 passed the turnstiles. The view of this immense concourse when seen from the vantage-ground of the Grand Stand after the parade of horses, was one not easily to be forgotten by any one who happened to have lingered to give a few minutes to its consideration; and when passing into the crowd the words of sentences in an unknown tongue were occasionally heard, proof was given that natives of the neighbouring Principality had eluded the vigilance of the sentries on the tower in the main street, and had come into England for the day.

Having thus cursorily glanced at the different features of the Show of 1884, which must be considered as having proved very successful, it only remains for me before passing into "the silent land" of the Society to say good-bye to those with whom I have been associated in the past three years, having, like my predecessor, reached the end of my course sooner than would have been the case under ordinary circumstances. To those gentlemen, my colleagues in the different departments, I beg to tender my best thanks for the kindness and consideration I have received during my tenure of office, the remembrance of which will constitute one of my most pleasing recollections. I also desire gratefully to acknowledge the unvarying courtesy of the many officials of the Society, and specially would I recognise the valuable help of the Assistant-Stewards, Messrs. Tindall and Beck, to whose accurate knowledge of detail and untiring exertions much of the order and regularity which distinguished the different parades is to be attributed.

XXI.—*Report on the Exhibition of Live-Stock at Shrewsbury*, 1884. By William Housman, Cantsfield, Kirkby Lonsdale.

By comparison of the entries in the Live-stock Classes for the Show at Shrewsbury in 1845, and the numbers of animals represented by them, with the corresponding entries and numbers in the Catalogue of the animals entered for exhibition at the same place in 1884, we shall get at a glance a fair notion of the pro-

gress of the Society, and of live-stock breeding under its encouragement, around the centre revisited this summer, after a lapse of thirty-nine years. Within that time several other meetings have been held in various parts of the area which, indicated by the letter "F" in the Society's division of England and Wales into seven districts, comprises Gloucestershire, Herefordshire, Monmouthshire, Shropshire, Staffordshire, Warwickshire, Worcestershire, and South Wales. In 1853, the Show was held at Gloucester; 1859, Warwick; 1863, Worcester; 1871, Wolverhampton; 1872, Cardiff; 1876, Birmingham; and in 1878 at Bristol, a city which, from its connection with the counties of Gloucester and Somerset, touches two of the seven districts. As this division, however, was controlled by geographical considerations, without reference to the distribution of the different breeds of live-stock (which varies as time moves on), it often happens that Shows held in one and the same district are strikingly unlike each other in the features of the department now engaging our attention. For example, comparing the Birmingham Show in 1876 with this year's exhibition, we notice that the Welsh Cattle, a prominent feature of the Shrewsbury Show, had no classes at Birmingham; while the Longhorns, at Birmingham remarkable for the strength and merit of the classes, made an indifferent display so far from their homes as they had to come to Shrewsbury. It would be useless, therefore, to compare the Show at Shrewsbury this year with Shows held at other towns in the same district, unless due allowance were made for all the local influences, not easily calculable, which affect the entries; but in the following comparison of the entries of 1845 and 1884, we have exactly the same centre, and the changes brought into notice must be regarded (with due allowance for increased facilities of transit) as the result of nearly forty years of work, the work of the National and other Agricultural Associations, and the work of private individuals, taught and stimulated by those Associations:—

	1845.		1884.	
	Entries.	Number of Animals.	Entries.	Number of Animals.
Horses	36	41	402	453
Cattle	173	173	566	673
Sheep	186	270	486	1316
Pigs	42	50	210	280
Total	437	534	1664	2722

The difference between the number of entries and the number of animals of course arises from such entries as represent, say, mares and foals, pairs, or larger numbers of cattle, and pens of sheep and pigs. In these figures the total number of entries in each class is taken without any deduction for the absent animals, whose entries appear in the printed Catalogue, or (as in a very few instances), having been cancelled, are indicated only by breaks in the continuity of numbering.

The Catalogue of 1845 is headed by Shorthorns, numbering 69 entries. Herefords follow, with 72 entries; then Devons, with 11; Cattle of Any Breed, 11; and Extra Stock, 10. Horses stand next in order: Agricultural, 28 entries; Thoroughbred Stallions, 4; Extra Stock, 4. Sheep: Leicesters, 75; Southdowns, 63; Longwools, not Leicesters, 23; Mountain Breeds, 14; Extra Stock, 11. Pigs, no distinct breed specified, are classed as Large and Small, and number altogether 42 entries.

The Catalogue of 1884, beginning with the Horse Classes, according to custom since 1867, when, in the absence of Cattle Classes, on account of the rinderpest, horses took the first place at Bury St. Edmunds, contains 155 entries of Shire and Agricultural, 54 of Clydesdale, 26 of Suffolk Horses, 85 of Thoroughbred Sires and Hunters, and 82 of Hackneys and Roadsters, including Stallions and the Pony Classes. Cattle were subdivided thus: Shorthorn, 108; Hereford, 144; Devon, 49; Sussex, 41; Longhorn, 14; Welsh, 60; Red Polled, 44; Jersey, 90; and Dairy Cattle, 16. Sheep: Leicester, 29; Cotswold, 18; Lincoln, 20; Oxfordshire Down, 41; Shropshire, 247; Southdown, 60; Hampshire Down, 21; Mountain, 40. Other Distinct Shortwool, 10. Pigs: Large White, 32; Middle White, 29; Small White, 47; Small Black, 17; Berkshire, 69. Any Other Distinct Breed, 16.

The classification accordingly is enlarged by the addition of Clydesdale and Suffolk horses, Hunters, Hackneys, Roadsters, and Ponies; Sussex, Longhorn, Welsh, Red Polled, and Jersey Cattle; besides a Class for Dairy Cattle without restriction as regards breed; Cotswold, Lincoln, Oxfordshire, Shropshire, and Hampshire sheep, with a class open to Shortwool sheep of breeds not specified; and by a more systematic division of the classes of Pigs, the separation of the Black from the White varieties, and of the Berkshire from all other breeds, distinct or indistinct.

The arrangements of the Showyard must not be overlooked, as the effective display of the live-stock depends so much upon them. It is the fashion in critical Reports to find fault, and even in its own 'Journal' the Society has permitted very

free comments upon its doings. Possibly from this fact, and certainly from the readiness of its Committees and officers to take notice of every suggestion likely to be of service, the excellence of the arrangements in a great measure proceeds. There is no hurrying to and fro, no shouting, no confusion, but the organization of management works like a perfect machine, or a military corps in the highest discipline. The marshalling of the classes, for show or parade, is conducted with exemplary order, quietness, and despatch.

HORSES.

The Council of the Royal Agricultural Society of England, ever ready to attend to reasonable suggestions, and to carry those suggestions, if practicable, into effect, must find considerable difficulty in dealing with the classes of heavy horses. Until recently, Suffolk horses and Clydesdales were recognised as of distinct breed, and all the rest for cart or dray were lumped together as "Agricultural." This latter section, which in the Show catalogues had precedence, was felt to be too comprehensive; the influence of the associated breeders of "Shire" horses became powerful, and the name of "Shire," recognised as genuine coinage, was received into the currency of the language. The Society first adopted it last year at York, adding to the Shire, Clydesdale, and Suffolk Classes, classes for such animals as were not qualified to compete under any one of these names. Suggestions that the Society will be asked to reconsider this classification were freely circulated at Shrewsbury. Some objection to the additional Agricultural Classes as unnecessary was met by a counter-objection to the Shire Classes as still too wide, admitting too many types and sizes. This latter is answered by reference to the conditions of entry, that the animal must be entered, or certified as qualified for entry, in the Shire Horse Stud-book. If for purposes of exhibition a fairer definition of a Shire horse can be suggested, those who know it would do well to bring it forward. The Society can hardly be asked to split a recognised breed; and with regard to type, the awards of the Judges year after year should sufficiently indicate and establish this. The other objection against the Agricultural Classes is embodied in a recommendation in the Report of the Judges. How far this recommendation accords with the spirit of the Society's customary practice is at present an open question. The somewhat strict conditions which seem necessary in order to weed out of the classes of distinct breeds all false specimens, may sometimes exclude merit which the Society would wish to recognise. So long as eligibility for a Stud-book

is made the test of fitness for a class, and until that Stud-book has gathered into its records all that is worthy of the Society's notice, the policy of exclusion must be at least of doubtful expediency. Three young Stud-books can scarcely rule the Royal Agricultural Society's action.

Some curious changes from group to group have certainly occurred within the last few years. One year an animal wins as "Agricultural," not qualified to compete in the Shire, Clydesdale, or Suffolk Classes, and is found the next year winning in the Shire Class. A mare and her daughter are at one and the same Show honourably mentioned by the Judges, the former as "Agricultural," the latter as Clydesdale; the same mare herself afterwards appears as a Clydesdale, and her offspring are most highly distinguished winners in the Clydesdale Classes. These facts arise out of the very reasonable condition, recently in force, that "horses entered as Clydesdales must be certified to have a recognised Clydesdale sire, and sire of dam" (now altered to eligibility for the Stud-book), and the failure of the owner to establish the identity of the dam's sire, in the case of his mare, while her daughter's pedigree conformed to the condition regarding the admission of animals as Clydesdales. Until the Stud-books have been many years established, there must be great numbers of animals of distinct but unrecorded breeding worthy to compete for the Society's prizes, but of course not able to pass the Stud-book test, and for these an open class seems desirable.

Improvements in the classification of light horses were also much discussed; but as the Judges of Hunters, and the Judges of the Hackney and Roadster Classes, in their respective Reports, have made their own suggestions, intended to meet the principal objections to the present classification, these objections need not be further noticed here.

The order in which the breeds are grouped in the apportionment of judicial offices is observed in the following notice of the several departments.

Shire and Agricultural.

As regards encouragement to farmers to breed improved horses of this stamp, the visit of the Society to the Shrewsbury district could scarcely have been more opportune. Within the last few years the importance of the subject has been fully realised in the district, and no fewer than four associations have been formed,—one at Shrewsbury, another at Ellesmere, a third at Ludlow, and one over the borders of the county of Montgomery,—with the object of procuring high-class cart or agricul-

tural stallions. Most of these associations have been working three or four years, and a marked improvement in the young stock of the district is the result.* An opportunity of studying the best types of draught horses was therefore specially desirable at this period, and such an opportunity the Show at Shrewsbury, a good, if not in any way a remarkably grand Show, abundantly afforded.

The different classes of Shire Stallions contained altogether 53 entries; those of Mares and Foals, 7; and of Fillies, 26; making 86 entries of Shire Horses exclusively: Agricultural Stallions not qualified to compete in the Shire Classes numbered 17; Mares and Foals, 5; and Fillies, 3 entries: and four classes were open to Shire and Agricultural alike, the condition being that the animals entered were not qualified to compete in the Clydesdale or Suffolk Classes. In these four classes were 9 entries of fillies and 22 of colts, 3 of pairs, mares or geldings, and 10 of single geldings, making a total of 155 entries in the Shire and Agricultural Classes.

The first Class of Stallions, 12 entries, three absent, comprised the winner of first honours at Reading and York, with the championship at the latter Show, and the horses also which respectively had the second prize and the reserved number at York. The York second was here first, the Earl of Ellesmere's bright bay "Esquire," who was accounted not only best in his class, but second-best of all in the three Classes of Stallions, and had the reserved number for the Champion Prize, won by the same exhibitor's two-year-old stallion, so that the Worsley stud doubly secured the honour; and if "Esquire," with his high bloom of condition and grand substance, had been as good in his fore-legs as elsewhere, he might have defeated his younger rival in the contest for the Shire Horse Society's prize. Some critics thought he ought to have taken it. Scarcely. The Judges, surely, were right! Mr. Crawshaw's iron-grey "Cheadle Jumbo," a well-known winner, came second; if he have not quite the high polish of "Esquire," he has, nevertheless, immense substance and power. The Cannock Company's "Earl of Chester" made a fairly good third; and Mr. Shepherd's brown, inclining to bay, "Commodore," a short-backed horse (from the great arch over shoulder and neck rising so far back), with a profusion of mane and leg "feather," had the reserved number.

* A veterinary authority, well acquainted with the powerful railway-horses and the dray and van-horses in the brewing and other industries of the Midland Counties, recently informed me that horses bred in Shropshire and Montgomeryshire improve and grow with work when put on good hard keep; whilst those bred in the Fen Counties lose flesh when put to work, and require a long time before they become "seasoned."—W. H.

If a wide-awake outlook, a bright eye, life and vigour in every movement, and the evidences of something like high spirit accompanying those of mere strength for a dead pull are desirable in a draught horse, the Cannock Company's "Nabob" has much to specially recommend him besides his true form, his well-set fore-legs, and his wealth of muscle. Sprightliness is not the term to apply to a horse of ponderous build, yet in contrast with the more stolid-looking horses of his own kind, "Nabob" had something not far short of it. He was well placed at the head of a class in which the Worsley grey, "Bismarck," third at York, advanced to the second place, and Mr. Beart's "England's Boast," a distinguished winner elsewhere, was third. Mr. Cheers' (the reserve), of the old English cart-horse black colour, has a good body, upon legs and feet that look likely to prove serviceable. Quite in the rear were one or two other noted winners; so the class of 12 entries, with only one absent, may be accounted a creditable one.

Class 3, Two-year-old Stallions, 29 entries, and 21 animals led into the ring, had four entries from Worsley, but two of these were in the list of absent. The two exhibited, splendid bays by "Royal Albert," were evidently somewhere about the head of the class, and were eventually first and champion and third, separated by Mr. H. Browne's "The Alderman," a brightish brown, of great growth, and more advanced development than "The Beau," Lord Ellesmere's third winner; while "King Charming," the first winner, took his place by unquestionable right. The Judges distributed their commendations liberally, but not with greater liberality than the merits of the class justified, and in their selections for favourable notice they evidently inclined rather to sterling merit, and the promise of future merit which the practised eye can see, than to mere good looks. Indeed, in the proper exercise of their discretion they passed over one or two animals which might have been noticed without bringing discredit upon their judgment, and so avoided the evil of lessening the value of "barren honours"—praises without substantial rewards—which, coming from Judges of the Royal Agricultural Society of England, should bear more weight than sometimes exhibitors allow to them.

Those Agricultural Classes which were open also to recognised Shire-bred animals were, on the whole, of considerable strength in the numbers and merits of the animals shown. Those from which Shire animals eligible for the Stud-book were excluded, were comparatively weak, and, on the ground of the paucity of entries, the Judges recommend their discontinuance. They did, however, contain a few animals of high merit, and as the same classes were last year, at York, fairly

strong and exceedingly good, and were included by the Judges in a general commendation of those and the Shire Classes together, as classes which "must always form an important feature in the Annual Show," it is questionable how far one indifferent exhibition, and that in a district in which four much-needed societies for the improvement of agricultural horses are yet in their infancy, is good reason for the abolition of the classes. The Class of older Agricultural Stallions certainly was weak; but the corresponding Class of Suffolks, which no one proposes to abolish, had not one animal in the Showyard. Messrs. E. and A. Stanford's useful brown horse, "Beaconsfield," stands sole representative of this class of Agricultural horses on the prize-list. A Montgomeryshire breeder came boldly into the strife with a three-year-old in the next class, but was beaten by three strangers, from Derbyshire, Notts, and Berks; while in the Two-year-old Class, Montgomery was actually foremost, with "Bangham," a horse bred by Mr. Henry Roberts in the same county, and exhibited by Mr. John Lewis. So much for the results of local effort. One of the three excellent mares so highly praised by the York Judges, Mr. Charlton's "Maggie Moir," took the second place at Shrewsbury, as at York, in the class of Agricultural Mares and Foals, and the Shrewsbury Judges placed above her the still better "Deborah Debbitch," exhibited by the Marquis of Downshire. The only other animals exhibited against these were both highly commended by the Judges (the fifth entry not appearing in the ring), so the class, as far as it went, was not very bad. The Agricultural or Shire Colt, and the Shire Filly Classes were excellent; the Agricultural Fillies formed two weak classes; and the Agricultural or Shire Class of Yearling Fillies was good. In this, one of the stock of "Spark," from Elsenham Hall, was first, the Worsley entries were second and reserve. The Hon. E. K. W. Coke's York second winner, "Czarina," was first in the Three-year-old Shire Filly Class, the same exhibitor's "Comfort" winning second; and in the Two-year-old Class the competition seemed close between the Earl of Ellesmere's "Lily," by "William the Conqueror," from the noted "Derby Beauty," and Mr. Gilbey's beautiful "Cosey," by "Champion of England." Mr. Gilbey's "Crowland Chief" headed a good class of last year's colts, upon which the Judges make some noteworthy remarks, showing their clear appreciation of the Society's objects, and of their own duties. Nothing can more surely ruin a breed than the systematic over-forcing of its young stock, and if Judges would more generally discountenance this bane of our improved breeds, they would do their country good service.

Judges' Report on Shire and Agricultural Horses.

Class 1—*Shire Stallion foaled in* 1877, 1878, 1879, or 1880—had twelve entries. We awarded first prize to No. 9 (and also placed him reserve for the Champion prize of 25*l.*, offered by the Shire Horse Society for the best Shire Stallion in Classes 1, 2, and 3), a massive animal, on short legs, well covered with silky hair. Second to No. 11, a grey of great substance; third to No. 10; reserve number to No. 12.

Class 2. *Shire Stallion foaled in the year* 1881.—No. 18, a heavy chestnut of the true Shire horse type, was placed first; No. 17, a grey, made a meritorious second; third, No. 19; had this colt possessed bone of better quality he might have been placed higher in the prize list; reserve number to No. 22.

Class 3—*Shire Stallion foaled in* 1882—had an entry of twenty-nine, and was decidedly the best class of Stallions, a matter of congratulation to see improvement in the younger class of animals. No. 45, a bay with good legs, feet, and pasterns, full of quality, a grand mover, was an easy first, and also took the Champion prize before referred to; undoubtedly this is one of the best colts seen of late years. Second prize went to No. 28, a grand well-grown colt, who was unfortunate in having to compete with such an extraordinary animal as the first-prize Stallion; third, No. 46, wants time, but promises to develop into a grand horse; reserve, No. 53; highly commended, Nos. 42, 38, 32 and 37; commended, Nos. 47, 31 and 27.

Class 10. *Agricultural Stallion, not qualified to compete in any of the preceding Classes, foaled in* 1877, 1878, 1879, *or* 1880.—Five were entered, but only three put in an appearance, two of which could not pass the veterinary examination. The first prize went to No. 97. The paucity of entries, and the inferior character of the animals shown in the Agricultural Classes, compel us to unanimously advise the omission of these classes from the future prize lists of the Royal Agricultural Society.

Class 11. *Agricultural Stallion foaled in* 1881.—First, No. 102, a useful heavy colt; second, No. 101; reserve, No. 99.

Class 12. *Agricultural Stallion foaled in* 1882.—First, No. 104; second, No. 107; third, No. 110.

Class 13. *Agricultural or Shire Colt foaled in* 1883, *not qualified to compete as Clydesdale or Suffolk.*—Some of the best colts in this class showed such evident signs of over-feeding, or want of exercise, that we were reluctantly compelled to pass them over. First to No. 111, a useful good moving colt; second, No. 121, a stylish bay; reserve, No. 119—had this colt possessed better pasterns he would have been placed before either of the others; highly commended, No. 114; commended, Nos. 129 and 131.

Class 17. *Shire Mare and Foal.*—The entries were few, but the mares as a class were grand animals. The first prize went to No. 168, a long, low wide mare of good style and character, with a good foal by her side; second to No. 167; third to No. 166; reserve to No. 165; the latter was a good mare, but the foal was crippled on the hind-legs.

Class 20. *Agricultural Mare and Foal.*—First, No. 187; second, No. 189; reserve, No. 188; highly commended, No. 190.

Class 24—*Shire Fillies foaled in* 1881—contained some very superior three-year-olds. No. 217, one of the weightiest and best mares of her age, was placed first; the second prize was awarded to No. 216, a stylish filly, with good legs and pasterns; reserve, No. 213; highly commended, No. 215; commended, No. 218.

Class 25. *Shire Filly foaled in* 1882.—Amongst the sixteen entries in this class we found some most promising fillies, the first going to No. 233, a well-grown filly of great substance; second, No. 220, was a beautiful filly of first-rate quality, but had not the same size as the first-prize animal;

reserve, No. 227, to which we recommended a third prize should be given. It seems somewhat strange that in the Classes for Sheep and Pigs, if there are six exhibitors in any class a third prize can be claimed, yet in the Classes for Horses no third prize can be awarded. We highly commended Nos. 228, 222, 226, and 235.

Class 30. *Agricultural Filly foaled in* 1881.—First, No. 260.

Class 31. *Agricultural Filly foaled in* 1882.—First, No. 262.

Class 32 was exceeding good. We selected No. 264 for first prize, a lengthy filly with capital fore-legs, which she can move with activity; second, No. 267, a black of great promise. If she goes on well, a grand future is in store for her. Reserve, No. 268; highly commended, No. 265.

The Pairs of Mares or Geldings in Class 33, and Agricultural Geldings in Classes 34, 35, and 36, require no comment in our Report.

P. G. Hughes.
Wm. Thos. Lamb.
Frederic Street.

Clydesdales.

The six classes of Clydesdales made a good show of 54 entries, 13 of these representing two animals each (mare and foal), so that the total number of animals entered was 67; but the absence of 7 single animals, and 2 mares with their foals, reduced the number to 45 entries, or 56 animals actually exhibited. The number of entries was within two of the number at York, where the show of Clydesdales was by far the largest that the Society has seen since the Meeting was held at the Border city of Carlisle in 1880. On that occasion the total number of entries in the usual classes was exactly the same as last year at York; but at Carlisle, on account of nearness to the home of the breed, an extra class for One-year-old Fillies was added to the five classes, and increased the number by 13 entries. Putting aside the number thus brought together, under exceptional advantages, the Shrewsbury figures compare very well with those of recent years; and in strength of merit the display was very creditable to the breed. Some of the exhibitors have connections with both England and Scotland. In the following classification of exhibitors, where the Scotch address is given in the Catalogue, the entry is placed to the credit of Scotland; where the English address is given, England has the credit, irrespective of the birthplace of the animal exhibited. The 54 entries are in the proportion of 43 English to 11 Scotch; three first, two second, and two third prizes go to Scotland; but one-third of the absentees are Scotch. These, in fact, were all the animals of one owner, Mr. A. Montgomery, of Kirkcudbright, and included his York first prize and Champion stallion, "Auld Reekie." The Duke of Portland's "Cairnbrogie Keir," however, a grand horse on good legs, which he used well in the ring, made a capital first winner; and the Marquess of Londonderry's horse,

"The Viscount," four years old (one year younger than "Cairnbrogie Keir), took the second place in his class the third time in succession, having won second prizes at Reading in 1882, and York in 1883. On both occasions he was beaten only by the Champion stallions; at Reading, by Mr. Rodgers's "Warlock," with whom he is mentioned by the Judges in their Report upon the Class, in terms of approbation applied equally to both animals, which are described as good and serviceable, and likely to improve the breed; and at York, where his sole superior was "Auld Reekie," he gained besides the money-prize a similar certificate of merit in the judicial Report. Both these horses, and the Hon. G. Waldegrave Leslie's third winner, "Leslie Lad," are bays, the last a horse of particularly attractive colour, such as American breeders look upon with great favour.

The Class of Stallions foaled in 1881, containing only five entries (and two of the horses entered had stayed at home), is noticeable for the merit of the two entries from the stud of Mr. Rodger, both sons of his "Drumpellier," who stood second to "The McGregor" at Derby. Both, also, are from very well-known mares. "Mystic," a large, upstanding, and powerful bay horse, among whose salient points of merit are his surpassingly good feet and pasterns, to which, as well as to his action, the Judges make special reference, is from "Mystery;" and "The Beau" is from "Bell," whose name is not, as might be inferred from *his* name, spelt with a final "e." "Mystery," who, with a foal by "The Beau," gained a high commendation in Class 18, has won honourable distinction in the Showyard; but her reputation rests most upon her great excellence as a breeder. She is the dam of "Warlock," the Reading Champion, and other winners. Among "Bell's" achievements was a third prize at Derby. Both these mares were on the ground at Shrewsbury. Their sons, although half-brothers by the sire, are not on the same level in present merit. "Mystic" is by far the better horse as he stands, and will probably keep the lead. He was third in his class at York. To him the first prize was on this occasion deservedly awarded; and "The Beau" had no rival nearly his peer in the contest for the second place. The Judges in their notes rather give him the cold shoulder; but he is regarded by some friends of the Clydesdale as a young horse that will improve, and that might have been thought a better one at Shrewsbury if his half-brother had not stood beside him.

Lady Ossington's magnificent bay two-year-old, "The Macneillage," the first winner in Class 6, is a son of "The McGregor," the celebrated horse which took the Society's first prize at Derby. The Judges, who in their notes refer to him as No. 75, give a faithful and perhaps sufficient description of his most

prominent characteristics. The second winner, "Leslie Rufus," a low-built chestnut horse, exhibited by the Hon. G. Waldegrave Leslie, looked little as he stood in his box, especially as his next-door neighbour on one side was a horse of comparatively gigantic proportions; but on that compact frame is muscle implying immense strength, of which, as we see when the horse goes out, nothing is wasted in bad action, his limbs are used with such ease and freedom. Mr. Loder exhibited a couple of very useful looking horses of his own breeding, namely, "Pirate" and "Whittlebury;" the latter is a bright bay with good action, third on the prize-list; the former is a brown inclining to bay, when a good light brings out the colour. Both are by "King of the Forest," and from Show mares. Mr. C. J. Lucas, Mr. R. Bowman, and Mr. G. Chapman, had useful-looking horses in the class; and Messrs. E. and A. Stanford, the well-known breeders of heavy horses and Sussex cattle, exhibited their "Earl of Ashurst," a horse that brings no discredit upon the reputation of their stud. The class, in short, had merit throughout.

A good Class of Mares and Foals contained, as stated in the beginning of these notes on the Clydesdales, 13 entries; but Mr. Loder's "Flora" and "Jess" were absent, and "Sonsie Queen" alone, the dam of one of his two-year-old horses, represented the adult female Clydesdales of Whittlebury. If the Report of the Judges throws any light upon the reasons for their decisions, we may infer that the merits of the mares alone influenced the Judges. The foals are not once mentioned. Form, action, and excellence in those parts which are so very essential to the usefulness of the equine race, the legs and feet, gave Mr. Kerr's "Bonny" her right to the first place; the perfect form but not quite perfect action of the Duke of Richmond's "Lily," first winner at Reading, brought her into the second place of honour; the third place was adjudged to Mr. Charlton's "Nanny," or "Nannie," the second winner at York, for general merit as a brood mare; and the reserved number, 179, is that of the Marquess of Londonderry's powerful mare, "Milkmaid." The high commendation of Mr. Rodger's "Mystery" (already mentioned) was the only further notice of entries in this class.

Number was not one of the recommendations of the Three-year-old Filly Class, consisting of only 5 entries, and one of the 5 absent; but two or three good animals, the first winner exceedingly good, made it a noticeable class. The fine young mare, whose unusually low condition for a Show animal did not prevent the Judges from owning her right to precedence, is an unnamed dark bay, bred by the Marquess of Londonderry, and

exhibited by Mr. J. H. Turner, of The Dean, Kilmarnock. By the sire she is half-sister to "The Viscount," second winner in Class 4. The Two-year-old Fillies, 11 entries, and only one absent, made an excellent class; two from Goodwood, one of which had the reserved number; two from Leslie, one taking the third prize; and one each exhibited by the Earl of Cawdor (first), the Duke of Portland (second), the Marquess of Londonderry (highly commended), and Messrs. Loder (commended), Lucas, and Charlton; the first, good in form and action, and very showy, was a general favourite; but there was also great promise of real usefulness in some of the less attractive-looking fillies.

Report on Clydesdale Horses.

Class 4. No. 60, first. This horse is a true type of the Clydesdale, having grand legs, ribs, and quarters; No. 61, second, is a big good horse, but a little out of form; No. 57, third, good size and colour.

Class 5. No. 63, first, a good horse, having good feet and pasterns, splendid action, and is likely to be a winner at some future Show; No. 64, second, not worthy of notice.

Class 6. No. 75, first. An extraordinary good horse having good feet and legs, splendid action, uncommonly good in chest, back and ribs; No. 72, second, a nice even horse, splendid back, quarters and ribs, and nice goer; No. 77, third, a big horse, a little plain in body, but is likely to develop with age. The others in this class were fairly good.

Class 18. No. 174, first, has grand feet, legs, and action, and is altogether a very superior mare; No. 170, second, a perfect model of the Clydesdale, her only defect being a slight stiffness in her pasterns; No. 175, third, a good brood mare, but a little worn in the legs; No. 179, fourth, a good strong mare, but a stiff goer.

Class 26. No. 241, first, a mare very lean in condition, with grand feet and pasterns, splendid action, and is certain to be heard of again; No. 238, second, nice sweet mare, but goes a little wide behind; No. 239, third, strong filly, but wants quality.

Class 27. No. 247, first, has grand legs, feet, and pasterns, splendid goer; No. 249, second, strong filly, grand fore-legs, but a little out of form; No. 245, third, very big, but wants quality. This was a very good class.

The Clydesdales as a class were very good, considering the distance they were from their native home, and are certain to maintain the reputation of the breed as the best draught horses in the world.

John Thompson.
Jas. Weir.

Suffolk.

"Far from home" is the plea in excuse of shortcomings in the Suffolk Classes. The entries number, altogether, exactly the same as last year at York, but the Shrewsbury prize-sheet gave one more class for Suffolk, which at York had no Class for Three-year-old Fillies. The classes at Reading, in 1882, were the same as at Shrewsbury, the entries 10 in excess of this year's, the number being, Reading, 36; York and Shrews-

bury each 26. But really, when the Suffolk stallions were led into the ring for parade, after the judging day, they did not seem to need much apology. As they moved past, and again as the rank of the chestnuts formed down the side of the collecting-ring, the breed made a display of which Suffolk men had no reason to feel ashamed. Yet this was merely a small deputation from its native county, comprising a few fair average specimens.

The Class of Older Stallions, unfortunately, was blank, so far as the judging-ring was concerned. The Duke of Hamilton's "Eastern Emperor," a winner at Reading and York, was entered, but was absent; so that the Suffolk stallion in the most mature development of his characteristics was unrepresented, except by one specimen, which appeared in the Three-year-old Class by mistake.

Mr. Biddell sent a couple of grand three-year-olds which won the first and second prizes in Class 8, containing 8 entries. These were "Prince Charlie," bred by Mr. D. Clover, sire "Rainham's Prince" (1002), dam, "Depper," by "Cupbearer" (410); and "Foxhall," bred by Mr. A. B. Biddell, sire, "Rodney" (161), dam, "Foxhall Depper" (67), by "Captain Snap" (142). Among the horses competing with them was Mr. Toller's "Verger," reserved number and highly commended, the second winner in the Two-year-old Class at York, a thick-bodied horse with grand neck, handsome, and, although on a somewhat large scale, quite a pattern of the Suffolk horse, as its distinctive character is understood by an outsider. But the Suffolks in general seem to be increasing in size, and in some instances showing proportionate variation from the very marked character exemplified in "Verger."

In the Two-year-old Class, 6 entries, Mr. A. J. Smith's "Ace o' Diamonds," by "Field Marshal" (1106), from "Diamond," by "Emperor" (644); and Mr. Wilmot's "Glemham," bred by Mr. Toller, and by "Cupbearer 3rd" (566), (a horse whose stock came out well in these classes), from "Venture" (922), by "Monarch" (1348), are respectively first and second; and in each class a son of "Cupbearer 3rd," from Wangford Hall, received a deserved commendation, in the younger class coupled with the reserve.

A couple of splendid mares with foals at foot, the Duke of Hamilton's "Belle of the Ball," with her foal by "Eastern Emperor," and Mr. Austin's "Darby," with a foal by "Chieftain," represented the matrons and infants of the breed; while the younger females were four very good three-year-old fillies, and two the property of one exhibitor in the Two-year-old Class. The Older Fillies numbered five entries, but one was

absent. Two of the name of "Pride" competed, half sisters, both by "Cupbearer 3rd," and highly creditable to the sire. The Duke of Hamilton's "Pride" was placed deservedly first, and one from the same stables, "Gaudy Poll," an easy first winner last year at York, had the reserved number; Mr. Toller's "Vixen" the second prize, and Mr. Wolton's "Pride" also received commendatory notice. Mr. Smith's filly by "Field-Marshal" was the winner in the Younger Class, his own "Saxstead" alone competing.

Report of the Judges of Suffolk Horses.

We regret to have had so few entries in this important breed of horses; but are aware that several who intended exhibiting their animals forgot to enter them until it was too late to do so; we hope another year this may not occur, as we consider it very desirable that there should be a good display of the Suffolks at the Royal Show. We may here remark that 20*l.* is not a great temptation wherewith to entice exhibitors to undertake a journey of 400 miles, with all the attending expense and hazard; perhaps, when the Society's coffers are more amply replenished, they may be induced to offer something beyond 20*l.*, as well as a third prize for a pure-bred class.

In Class 7, nothing was brought before us; the name of one only appeared in the Catalogue, and he was an absentee. This is the more to be regretted, as the Spring Show at Woodbridge, the heart of the home of the Chestnuts, was the finest display of all-aged Suffolks that has been witnessed for years. By an oversight of the owner, No. 87 was entered with the 3-year-olds, or he would have appeared as a representative of this class. By an equally unfortunate mistake, Mr. H. Wolton entered his 3-year-old, No. 93, in the 2-year-old class.

Class 8.—Mr. M. Biddell's "Prince Charlie" was first, and his stable companion, "Foxhall," second; with Mr. J. Toller's "Verger," reserved and highly commended. No. 82 was also commended.

Class 9.—Mr. A. J. Smith's "Ace o' Diamonds" was first, and Mr. R. R. Wilmot's second, with No. 88. No. 91, reserved and commended.

Class 19.—Only two out of the four mares and foals entered put in an appearance; but their quality was all we could desire. The Duke of Hamilton's "Belle of the Ball" was first; and Mr. Austin's "Darby" received a second prize, by our recommendation.

In Class 28 there were four very good fillies exhibited. The Duke of Hamilton's "Pride" was placed first; Mr. J. Toller's "Vixen," second. No. 256, reserved and highly commended; No. 257, commended; No. 254, absent.

Class 29.—There were but two entries in this class; both belonging to Mr. A. J. Smith. No. 259 received first prize.

Arthur Wm. Crisp.
Edward G. Hodgson.

Hunters.

Mr. Wicksted, Master of the Ludlow Fox Hounds, writing to Mr. Bowen-Jones, on February 19th, 1883, the letter which appears among the contributions to Earl Cathcart's invaluable paper upon the "Breeding and Management of Half-bred Horses

for Road or Field" ('Journal,' vol. xix., S.S. Part I., p. 1), says that the breeding of hunters in the neighbourhood is (to that date) unquestionably on the decline, but that the district is a most suitable one for horse-breeding, and was in former days noted for its good hunters, great in their capabilities as weight-carriers, and in their powers of endurance. These animals, bred in the district, a hilly one, needing strong and untiring horses to hunt it, made "the Shropshire type" famous, a type at once understood if the words used as quotation were applied to purposes of description. From one cause or another, or from many causes, that state of things passed away, and the country around Shrewsbury has lost its reputation as the breeding-ground of a special stamp of hunter. In connection with one of the associations recently formed to promote the breeding of improved cart-horses in the district, mentioned in an earlier part of this Report, an effort has been made to revive also the breeding of hunters and hackneys. In December last, the Ludlow District Cart-Horse Association resolved to form a Limited Liability Company uniting the two latter varieties of horses with the cart-horse, with the object of effecting improvement by the introduction of superior stallions to travel the district. The Ludlow Stud Horse Company (Limited) was accordingly incorporated in January last, and it now has, besides two shire stallions purchased, the hired thoroughbred horse "Prince George," by "Toxopholite," the property of the Duchess of Montrose. These horses, it is understood, have been fairly well patronised during the season; but as this is only the beginning of that which may prove to be, hope suggests, the revival of horse-breeding in the district, Shropshire and the adjoining counties did not contribute much to the quality of this department, although a few good horses and mares, home-bred and strangers, belonging to exhibitors resident in the district, were shown.

Before we turn to the Classes of the Hunters themselves, the Thoroughbred Stallions suitable for getting Hunters claim attention. Much has been said about the importance of some security that the winning horses should be available for the use of tenant farmers; and it is understood that the Stock Prizes Committee will be asked to consider whether a condition to that effect should be attached to the offer of prizes. Whether such a condition should come from the Society itself, or is rather within the province of a local committee offering special and supplementary prizes, may be a further question. As an obvious objection to any restriction, it may be urged that such a change is likely to exclude the best specimens of the thoroughbred, whose owners would not care to subject them to compulsory service; and something may be said about a possibly incon-

venient precedent for similar restrictions upon the exhibition of bulls, for instance. But perhaps advantages sufficient to overrule these objections may be shown.

In the Class for Stallions of the description indicated, Class 14, the 13 original entries had been reduced to 12 by the withdrawal of No. 145, and the 12 entries to 10 horses in actual competition. The Earl of Bradford's "Retreat" ("Hermit"—"Quickmarch") and "Chippendale" ("Rococo"—"Adversity") both horses of note, were among the entries furnished by the county; but as the former horse's box was empty, "Chippendale" alone stood for Weston in the ring, and most effectively, too, for there was "nothing to touch him," according to Showyard phraseology.

The Mare and Foal Class, 7 original entries, 6 in the Catalogue, and all the 6 represented by animals in their places, is passed, like the Stallion Class, in marked silence by the Judges, so far as regards criticism upon the animals. Upon the mares and foals, the only comment is that they should be separated. How far a class of infants alone, of any kind of stock, may be desirable, is a question which may be suggested for consideration together with the proposal of the Judges. Fat calves, we know, are most deceptive, most difficult to judge, and calves which are not fat had better stop at home. Foals in July of the year of their birth are usually not more trustworthy than calves. If exhibited for separate prizes, they must still, probably, come into the ring with their dams, whose merits would more or less impress, if not influence, the Judges. The theory of the class, as at present constituted, is understood to be that the mare chiefly rules the decision; but that as a well-shaped brood mare should be able to lead into the ring a well-shaped, healthy, and well-nourished foal, the foal accompanies her in order to prove the breeding and rearing capabilities of the mare. In the Class at Shrewsbury, the Duke of Hamilton's chestnut "Flirt," bred by Sir G. Cholmley, with her foal by "Greenback," was first winner in the company of two Shropshire-bred mares (Mr. Hill's second, a brown, named "Gluepot," and Mr. G. J. Dunville Lees' bay, "Clara," third winner), and three from different counties of North and South Wales.

Seven Classes of Mares, Geldings and Yearlings contained 65 entries. Class 37, Weight-carriers, Mare or Gelding, had 11 entries, 2 absent. Class 38, Light-weights; 8 entries, 2 absent. Class 39, Four-year-old Mares; 5 entries, all shown. Class 40, Four-year-old Geldings; 15 entries, 5 absent. Class 41, Three-year old Mares; 8 entries, all shown. Class 42, Three-year-old Geldings; 10 entries (including one withdrawn), 3 absent. And Class 43, Yearling Colt or Filly; 8 entries, one absent. Upon

three of these classes the Judges report unfavourably, applying to each of the three one general comment, "Very bad." In Class 37, however, Mr. Thomas's "Gendarme," and Mr. Brown's "Grenadier," surely forbid the application of the censure to every unit composing the class. In Class 38, the withdrawal of the third prize seems anomalous in connection with the grant of a reserved number, because in the event of the first or second prize-horse proving disqualified (we have a right to suppose the possibility, as it is only in view of the possibility of such a case that a number is reserved), then it would happen that a horse unworthy to receive a third prize would take by right the second prize. When a prize is thus withheld, because the merit is insufficient to deserve it, should not the chance of unworthy succession to a higher prize, still less deserved, be barred by refusal to grant a reserve?

For insufficiency of numbers, and not for want of merit, the third prize in Class 39 is also withheld. Mr. Lett's, Mr. Toppin's and Mr. Blakeway's mares (Yorkshire, Cumberland and Shropshire represented), have their certificates of merit; but Mr. Southam's (Shropshire) and Mr. Wheeler's (Worcestershire), one of which must have taken the third prize, if paucity of number had not ousted the jurisdiction of the Judges, are sharers of the general commendation implied in the Judges' Report.

Of Class 40, a general commendation is put upon record in the awards, so that besides Mr. Mitchelson's "Mars" (Yorks), Mr. Brown's "Victor" (Yorks), Mr. Keevil's "Garrison" (Wilts), Sir Wilfrid Lawson's "Brayton" (Cumberland), and one horse specially commended, every horse went home with the judicial approbation upon him. A good bay Lancashire-bred three-year-old, belonging to Mr. Abbot, in Westmoreland, was the first in Class 42; Herefordshire and Shropshire horses taking the two other prizes; and the reserve belongs to Warwickshire. The only prize offered for Colt or Filly Foals of last year went to the brown filly "Madge," bred and exhibited by Mr. Huddleston (Worcestershire), and Mr. Jackson's bay colt (a specimen of Shropshire breeding) has the reserved number. Altogether the counties close around this year's centre had a fair share of the honours.

Report of the Judges of Hunters.

We beg to suggest that in Class 21 a separate prize should be given for mares and foals distinct, instead of for the two combined, as at present.

Class 37.—We consider the Weight-carrying Hunters very bad; only two out of the number being up to 15 stone.

Class 38.—We consider this class very bad, and we were compelled to withhold the third prize.

Class 39.—We consider this class good, though the entries were small, and consequently no third prize could be given.

Class 40.—We consider this class very good. The horses were full of quality, and plenty of substance and action, and we wish to commend very highly this class.

Class 41.—A very bad class; small, weedy animals, bad movers; no quality.

Class 42 was a good class.

Class 43.—We consider this class a very good one. Some very nice foals shown.

Reginald Chandos Pole.
Le Gendre N. Starkie.
Walter H. Long.

Hackneys, Roadsters, and Ponies.

Under this heading, again, we begin with the sires. Class 15, for Stallions suitable for getting Hackneys, above 14–2, and not exceeding 15–2 hands, had only five entries, and one was absent; but Mr. Grout's "Fashion" is worth a great many horses of the average character. As this horse has been described in Earl Cathcart's Paper and in the official Reports of the 'Journal,' and the Judges this year acknowledge his merits, not only by their award, but in their notes, little need be added here. "Fashion," is a black-brown, six years old, and was bred by Mr. Robert Wortley, not Worsley, as repeatedly misprinted, of Suffield Hall, Norfolk. His height when rising four years old is stated as 15–1 hands. He has now won the first prize in his class three years consecutively, besides many prizes elsewhere. The same horse, "Lord Derwent," which won the second prize in the same class at York, where he was exhibited by his breeder, Mr. Robert Martin, of Scoreby Grange, but this year belongs to Major Platt, has the reserved number—the chestnut, "Fascination," from the High Hurst Manor Stud Farm, in Sussex, separating the York winners.

In the Pony Stallion Class, twelve entries, eleven shown; two were disqualified as over height. The three winners were very choice, but the class, as a whole, did not display any very great strength.

A reversal of the York judgment occurred in the placing of the first and second prize Hackney Mares and Foals, the same mares having been last year respectively third and second. Both are uncommonly good animals, and if Judges take much account of the foals (although they do not say much about them) it is quite possible that the quality of the year's foal may have turned the scales differently in the two years. The class of eight, only one absent, was a good one in the aggregate.

Mr. Glossop's excellent pony mare, first in the same class at

York, is the only noteworthy animal in the Pony Mare and Foal Class of four entries, all shown.

Mr. John Robinson, of Hull, a successful exhibitor in the same class last year, had the two best animals, both mares, a black and a chestnut, in a middling class for Hackney Mares and Geldings, not exceeding 15–2 hands and up to 15 stone; and in a very much better class of lighter-weight hackneys, seventeen entries, twelve in the ring, besides his entries winning the third prize and the reserve with a high commendation, his black "Lady Shrewsbury," a half-sister to his black "Lady Cremorne," first winner in the heavy-weight class, had the first place. They are both very superior animals of true form, with strikingly attractive looks, and are admirable movers. Mr. Frisby's bay gelding, "Cardiff," a high-class specimen of another type, had the second prize, and his noted skewbald mare, "Movement," only had a high commendation.

There was much merit in the strong Class of Mares or Geldings of 13–2 to 14–2 hands, Class 46, containing sixteen entries, only two absent, and one disqualified as over height; and in a class of ten entries of Ponies (Mares or Geldings) under 13 hands, although three were absent, the quality of the seven competing was very satisfactory.

Report of the Judges of Hackneys and Roadsters.

Class 15.—The first-prize horse, "Fashion," well known in the prize-ring, is an admirable mover, with plenty of quality. The rest were a very moderate lot.

Class 16.—First prize, a good mover, with plenty of substance, and wonderful thighs; second prize, a nice mover, but a little strong in his neck; third prize, a nice pony, full of quality. The two first are by the noted pony, "Sir George," and the third by "Little Wonder." All the rest were far behind them.

Class 22.—The first prize was a very grand mare, and a model of what a roadster mare should be; second prize, a beautiful mare, full of quality, with her head and neck well set on; third prize, a grand old mare, full of quality; but her day has gone by for the Show-ring. A very good class.

Class 23.—First prize, a real nice mare, with a very grand foal. The rest were very moderate.

Class 44.—First prize, a valuable animal, with grand quality and action; second prize, belonging to the same owner, has rather less bone. The rest are very moderate animals.

Class 45.—First prize, a very grand mover, with wonderful action and quality, and a pure type of roadster; second prize, a regular park hack, which can do all its paces well, but of an entirely different stamp of animal to the first prize. It is difficult for the Judges to keep to any particular type when Hackneys and Roadsters are shown together; and we think the Judges might take this opportunity of suggesting to the Council the desirability of having one separate class for Park Hacks any height, and wording the other classes for "Roadsters;" then two distinct classes of animals do not get mixed up together in one class. Third prize is a pure roadster again; but more suitable for harness than saddle. This was the best class we had before us.

CLASS 46.—First prize, a very grand pony, and true goer all round—the only thing against it is its colour; second prize, a well-known face, and wonderfully fresh for her age, but more suitable for harness than saddle, as she dwells too much in her action. There were other useful ponies in this class.

CLASS 47.—First prize, a grand-shaped pony, with liberty of action, and a perfect miniature hunter in shape. This was a good class.

GEORGE O. WOMBWELL.
CHRIST. W. WILSON.

CATTLE.

A difference in the order of arrangement between the classes of horses and those of cattle would admit of an entirely different order of notice. The cattle, male and female, being classed consecutively under their breeds, and not, like the horses, classed according to sex and age, the same breeds appearing, disappearing, and re-appearing as the pages of the Catalogue are turned over, might be noticed under the heads of their breeds severally in the exact order of the Catalogue, without regard to the group assigned to each judicial triumvirate; but, to avoid splitting one brief judicial Report into three parts, a compromise seems expedient, therefore in the following notes and comments the Shorthorn and Hereford cattle, each breed having three Judges for itself alone, take their Catalogue order of precedence, the Devons and Sussex follow; but as the Red Polled cattle were judged by the same Judges who officiated in the Devon and Sussex Classes, the Polls are taken up from a later part of the Catalogue and placed immediately after the Sussex Classes. As these Judges, however, have sent in three separate Reports, we are enabled to glance at the breeds under separate headings. The Judges of Longhorn, Welsh and Dairy Cattle have supplied only one Report. For this reason, and the Report being too short to divide, one heading stands for these classes; and the Jerseys, which precede the Dairy Cattle in the order of the Catalogue, are, by the accident of circumstances, and not from any want of respect for their merits, left to the last. Whatever place they occupied, they would make that the post of honour, or otherwise, according to their merits. Upon this occasion they certainly added to the credit of a very good Show.

SHORTHORNS.

Viewed in comparison with other breeds upon the same ground, the Shorthorn was creditably represented at Shrewsbury; in comparison with the Shorthorn itself, as represented at some former Shows (but not, perhaps, with the average Shorthorn of the "Royal" Shows of the last thirty years), it did not

make a first-rate display of its merits. Read in the full recollection of the female Shorthorn classes, and of a few specimens prominent in the male classes, the Report of the Judges strikes one as unnecessarily chilly; but, according to the high standard evidently taken by the Judges, it is perfectly correct. We have seen better shows of Shorthorns, much better shows of bulls.

In order to appear on the ground at all, the Shorthorn had to pass into Hereford territory; and although it claims an established footing in Shropshire, and even in Herefordshire itself, while the Principality is often victoriously represented in the Shorthorn classes of the national Shows, the number of Hereford herds crowding in the foreground made the Shorthorn a comparatively outside breed, and the distance from districts heavily stocked with Shorthorns unquestionably affected the entries of the breed. There was really no reason for despondency on the part of Shorthorn breeders and their well-wishers, but, on the contrary, very great reason for them to take to themselves encouragement and congratulation from so good an exhibition so near the headquarters of their strongest rivals.

The Class of Older Bulls bears an unfavourable contrast to the corresponding class in 1845, as regards the number of entries, 20 on the earlier occasion, and only one-fourth of that number now; but the Shorthorn Bulls altogether number now 49 entries of single animals, and 4 of sires with their progeny, against 40 single entries in 1845. The female Shorthorns number 55 entries, including 7 pairs of heifers and 2 entries of cows and offspring, besides the females exhibited in the Dairy Classes and as the progeny of bulls exhibited, together with their stock. The female Shorthorns in 1845 numbered 29 in the regular class, and 3 heifer calves, with or without pedigree, were exhibited as Shorthorns in Extra Stock. If the Shorthorns have not increased in number so much as some other breeds, the fact that they had at that time a Herd-book of twenty-three years' standing, while no other breed had a Herd-book, and that they were then, as now, established in nearly all parts of the kingdom, must be borne in mind. Among the exhibitors of Shorthorns at Shrewsbury in 1845 were many whose names are now venerated as historical. The name of Mr. H. W. Beauford is still associated with the breeding of high-class Shorthorns. Among Mr. Beauford's co-exhibitors were Lord Hill; Mr. Banks-Stanhope, whose "Cramer," bred by Mr. Parkinson, of Leyfields, and "Ladythorn," bred by Mr. John Booth, of Killerby, were the first winners in their respective classes; Mr. Topham, of Keal, in the same county, Lincoln, with Mr. Lister Maw, whose "Hecatomb" had beaten Mr. Bates's "Duke of Northumberland;" Mr. H. E. Strick-

land, of Apperley Court (need anything be said about the Strickland influence upon Shorthorn breeding in Gloucestershire?); Messrs. E. Lakin and Herbert (great in the adjoining county of Worcester); Holbech, of Farnborough, and Lovell, of Edgcott (Oxfordshire); Champion, Burgess and Frith (Notts); C. W. Harvey, of Walton; Almond, of Orrell; and Bannerman, of Chorley (Lancashire); Sir Charles Tempest and Messrs. Carruthers, of Arthington Hall, and J. D. Jefferson, of Thicket Priory (Yorks); together with others whose names have almost passed out of Shorthorn history, although they were prominent in that day. With such exhibitors the Shorthorn show of nearly forty years ago could scarcely be far behind that of to-day; and there are "old stagers" who would tell us, no doubt, that it was far better than anything this degenerate age can produce. Be it so; let us see what this degenerate age *has* produced.

First, we have a Class of five Bulls, one absent, two certainly grand animals, but of the unfashionable white colour, so falsely associated with delicacy and tenderness, notwithstanding Nature's standing protest against the doctrine, by her persistent selection of that colour for the animals of the coldest regions. Mr. Foljambe's "Bright Helm," winner of first prizes at Reading and York, and Mr. Handley's "Hovingham," better known as Sir W. C. Worsley's, second at Derby and York, have both received high testimonials of merit in the Official Reports of the Shows at which they were successfully exhibited, and a sort of prophetic intimation of "Hovingham's" undeveloped power to "turn the tables" upon a rival who had beaten him, is justified now by his well-won victory over another rival who had been twice in the higher position, but not in the same class, with "Hovingham." They had, however, met before they came into the ring at Shrewsbury, and Judges differed respecting their comparative deservings. The Shrewsbury Judges had probably a slight balance of outside opinion in favour of their decision when they awarded the first prize to "Hovingham;" but the contest was extremely close, probably the closest in any of the Shorthorn Classes.

A good bull is good for nothing if his stock are not good. "Bright Helm's" may have every desirable property, but a specimen of "Hovingham's," "Self-Esteem 2nd," the champion bull of last year, was on the spot, to prove his sire's worth, and in Class 49, five entries, was easily picked out as the rightful first-winner. With this exception, the class wanted high character, although "Duke of Cornwall," bred by his exhibitor, Mr. Tregaskis, but on both sides from Colonel Sir R. Loyd

Lindsay's excellent distributed herd, has the qualities of a very useful Shorthorn sire.

Class 50, Bulls calved in 1882, contained seventeen entries, but two of the animals were absent. The Judges did not consider that the fifteen which came into the ring constituted a strong class, yet they distributed three prizes, a reserve and high commendation, and four commendations, among the competing animals; and eight animals worthy of special commendation, without the seven unnoticed, should not be a contemptible class. The reserved bull had been the winner of the cup at the Royal Dublin Spring Show, where competition is exceedingly strong, and certainly came before the Judges at Shrewsbury in capital form and condition, not over-fed, but level and thick-fleshed. In this attempt to do mere justice to a good bull, lest his fourth place in "not at all a strong class" might be supposed to imply less merit than "Tel-el-Kebir" possesses, no dissent from the judicial decision is intended. The right of place of Mr. Green's "Prince of Donyland," Mr. Coomer's "Sir Stafford," and the Duke of Northumberland's "Polar Star," is not questioned; and although the commendations were more in number than a weak class usually receives, no one could have maintained objection against the award if the judges had extended their notice to the Duke of Devonshire's level and not over-fed "Duke of Oxford 62nd," and Mr. Duncombe's not thoroughly handsome but deep-bodied and solid-fleshed young stock-bull, "Sir Isaac Newton," a son of "Sir Arthur Ingram," "Hovingham's" sire.

The first-winner in a capital Class of Yearling Bulls, Mr. Handley's "Royal Ingram," is also a son of "Sir Arthur Ingram." Another Cornish bull, Mr. Trethewy's "Star of Cornwall," by "Star of Britain," bred by Mr. Talbot-Crosbie, took the second place; and the third was filled by Mr. Pugh's "Bright Andrew," of Mr. W. Torr's "Bright" tribe, directly descended from Mr. R. Booth's "Anna," the cow that sixty years ago walked from Studley, near Ripon, to Manchester, took the first prize there, walked home again, and within a fortnight gave birth to the bull "Aaron," not to the heifer, "Young Anna," as stated in the late Mr. Carr's admirable work on the Booth herds, unless history is quite at fault about the date of the Show, 1824.

Opinions were freely interchanged upon the usefulness, or the contrary, of Class 52, in which Bulls of Any Age, each with two, three, or four of his offspring belonging to the same owner, might compete for the prizes of 50*l.*, 30*l.*, and 20*l.*, offered by the Shorthorn Society. Four groups were entered for competition,

and all brought into the judging-ring. One consisted of the sire, five years old, a two year-old heifer, two year-old bull, yearling heifer, and heifer calf; the second (in the order of position in the Catalogue) contained a bull, eleven years old, two cows, aged respectively seven and five years, and a bull four years old; the third, a bull of four years old, as the sire, a couple of heifers about two years old, a bull of about twenty months, and a heifer-calf; and the fourth, a sire aged nearly six years, a two year-old heifer, two yearling heifers, and one yearling bull. Family classes are now looked upon with much favour, as having a greater tendency than the exhibition of single specimens to encourage general improvement in the herds of the country. Some persons have entertained the idea that the action of the Royal Agricultural Society of England might be usefully extended to rewards for the best herds at home; but as this is already to a certain carried out in the awards of prizes for the best-managed farms, and as the educational advantages of bringing before the public in the Showyard the best farm live-stock that the country can produce, are important, it is difficult to see how the principle suggested can be better observed than in the offer of prizes for family-groups or other collections of animals; as for example, four heifers belonging to the same owner, as exhibited in two classes of the Hereford section at Shrewsbury. The chief objection against the class which competed for the Shorthorn Society's prizes was on account of the inequality of the ages of animals contained in it, and the consequent difficulty of justly balancing the merits of the "promising" young cattle, and of cattle which had passed their best days, against those of cattle in the prime of maturity and height of condition. This may be worthy of consideration, although amendment of the conditions does not seem very easy, and the same objection that applies to the exhibition of bull and offspring applies with still more force to the exhibition of cows with their offspring. Approximate equality in age, if that is sufficiently desirable, might be secured by the insertion of a condition that the offspring of the bull should be all calved in one year; but that condition would not be applicable to a class for cows and their offspring, because a cow, in the ordinary course of breeding, does not usually produce more than one calf in the year. The fact that one or two of the bulls had better stock elsewhere than in the class with them, was also urged as an argument against the usefulness of the class, upon the ground, that if the first prize were awarded to a bull which is not really the best stock-getter, the second prize to one which is not the second best, and so forth, the object of the Shorthorn Society in offering the prize would be defeated. The object, it is assumed, is not to give the prize to

the best bull *per se*, but to the best *sire—i.e.* to *the sire of the best stock*. This assumption is not quite correct. The prize is to the bull and his offspring; to the bull, for his personal merit, as much as to his offspring, for their personal merit. If this were not so, the bull need not appear. The Judges were not bound to take into account—rather, indeed, like juries in assize courts, they were bound *not* to take into account—anything besides the evidence presented to them in the course of trial; and that evidence was the personal merit of the particular animals of each competing group. Upon that understanding their duties were very faithfully and very ably discharged. The prizes were awarded to the groups in the order of merit as the animals appeared in the ring, and if any exhibitor could have made up a better group than he did make up, and failed to win as much as was within his reach, he has only himself, not the Judges, nor the terms of competition, to blame. As a matter of fact, the first prize went to a group headed by a very excellent sire, Mr. Thompson's "Beau Benedict," of whom it might be truly said that if any other bull had good offspring elsewhere than in the class, so had he. This well-known bull, a son of Mr. J. B. Booth's "Paul Potter," was bred by Mr. W. Linton, and now, in his sixth year, looks more fresh and active than ever. His accompanying offspring were the three beautiful heifers, "Inglewood Belle," "Inglewood Pride," and "Lady Millicent," and the roan two-year-old bull "Royal Baron," who bears a strong resemblance to "Beau Benedict." The beauty of Mr. Ackers's two older heifers, "Western Georgie" and "Lady Carew 13th," a pair of roans, must have gone far to place his group next on the list. Their sire, "Royal Gloucester," with forequarters deep as a bison's (no further or uncomplimentary comparison with that animal intended), was in plain condition, not handsome, but really good in the more important points of structure. In Mr. Wakefild's group, "Baron Barrington 4th," past his eleventh year, a fine type of stock bull in lean condition, and his son "Baron Sedgwick," a noted winner in previous years, were the specially remarkable animals; and Mr. Pugh's group contained another good lean bull, of quite a different sort, not showing that distinctness of type which characterised Mr. Wakefield's really grand old "Barrington" bull, but in the unobjectionable structure of his frame, and in the various evidences to the hand and to the eye, that he can thrive rapidly, commending himself to the man of a practical turn of mind. The Judges' emphatic commendation of this as a most satisfactory class, and their suggestion that its continuance is very desirable, represents, notwithstanding all the objections that have been put forward, a very strong and general feeling.

The sifting effect of long distance from home was remarkably exemplified in the first of the classes for female Shorthorns, Class 53. Seldom has a class of cows so good throughout been seen. Never, since the Meeting at Bristol in 1878, has this class been so small. The entries, erased numbers counted, are: Bristol, 9; Kilburn (International), 25; Carlisle, 19; Derby, 14; Reading, 15; York, 14, and Shrewsbury, 10; or, omitting erased numbers: Kilburn, 23, and Carlisle 18, the rest as stated. Of the 10 cows entered for Shrewsbury, 8 were in their places on the Showground, and each one received judicial notice. Mr. Brierley's white cow "Snowflake," at once massive and compact, whose beauty would be improved by a somewhat larger and more open pair of horns, was placed, as at York, at the head of the class, Mr. Hutchinson's roan "Gratia," who had the reserved number at York, taking the second place. She is a very characteristic specimen of the Booth type of cow, with deep and finely moulded fore-quarters, good back, and the head and general character of that type. Mr. Gibson's "Queen of Stroxton," a full-red cow of great substance and beauty, had the third prize; Mr. Ackers's roan "Lady Georgina Newcomb," the winner of many prizes, the reserved number and a high commendation. High commendations also were adjudged to the Duke of Northumberland's "Sunshade;" Mr. Green's "Gaiety," roan, a noticeably lengthy and stylish cow, second to "Snowflake," and placed before "Gratia," at York; and Mr. Pugh's "Czarina Manoravon," a massive and showy roan cow, in full condition; Mr. Rolls' "Siddington Blush 2nd," a rich red, of great style, received a commendation. This last is a descendant of the "Old Daisy" tribe, so highly estimated by Mr. Bates, and at Mr. Charles Colling's sale in 1810, by the public in general. It was carefully preserved by Mr. Priestley through many generations in a remote part of Wales, and has come into prominent notice again within the last few years. Two or three of these cows, having previously done their duty at the Shows, were beginning to look somewhat like fruit with the bloom rubbed off, but not to the extent of the breaking up which commonly follows the strain of early forcing.

A class of only four Cows or Heifers calved in 1881 was remarkable for the excellence of the prize and reserved animals, and the surpassing excellence of the first winner, Mr. Hutchinson's "Lady Pamela," very full of the old Warlaby character, with a fore-rib reminding us of "Queen of the Ocean's," and shoulders of vast width and neatness, like those of the famous "Stratton" heifers, or Mr. Kidner's Devon steer at the Smithfield Club Shows a few years ago. The only question was,

whether Islington or Bingley Hall is not the right place for an animal in her condition. She has bred one calf, unfortunately dead, and the hope may be expressed that she can yet breed living calves, of healthy constitution, to perpetuate her own merits. Mr. Ackers has the credit of breeding Mr. Hutchinson's second winner, and the reserve belongs to a granddaughter of the Rev. R. B. Kennard's celebrated winner, "Queen Mary."

Mr. George Ashburner's "Lorne" family, good, massive, useful Shorthorns, not quite of "the caste of Vere de Vere," took without rivalry the honours of Class 55. In Class 56, Heifers calved in 1882, fifteen entries, only one, from illness, absent, Mr. Wakefield's "Augusta 4th," an exceedingly handsome heifer, first in her class at York, again took first honours. She is a red and white, with a beautiful head, quite the Shorthorn old style, and flat, waxy-yellow horns, very ornamental; in merit, from a practical point of view (if a good head does not count, as it should count, among the recommendations of an animal to practical-minded men), she is also great, having a symmetrical and well-grown frame, amply covered with evenly-laid flesh. Mr. Pugh's "Zoe 2nd," a flecked roan, by "Sir Charles," his bull in the Sire and Offspring Class, took the second, Mr. Fox's "Red Rose of the Tees 3rd," a good red and white heifer, descended from the "Red Rose" tribe of Mr. Bates and Mr. Robert Colling, through the hands of Messrs. Renick in America, the third prize, and the reserved number belonged to Mr. Brierley's "Empress 18th," a really good heifer, rich in flesh and hair, roan, with a good head of the quiet sort. Sir H. Hussey Vivian's "Pride of Glamorgan," of the "Stratton" strain of blood; Mr. Chalk's "Sybil," by "Duke Oneida," from a dam of the prize-winning "Telemachus" strain; Lord Tredegar's pretty grey-roan, "Marigold 15th," and Mr. Brierley's "Rosedale Duchess," a daughter of Mr. Sharp's York third-prize cow, were also heifers of distinguished merit in this class.

Heifers calved in 1883 numbered sixteen entries, thirteen in the ring, and the competition was good, that is to say, a sufficient number of animals had sufficient merit to make the competition real and the result interesting. Five commendatory notices were given, in addition to the three prizes and the place of reserve, with its accompanying high commendation. Mrs. McIntosh exhibited the first winner, "Havering Nonpareil 2nd," a full red-roan, of great growth and length, with a strong and well-covered back. A certain especial interest attaches to the awards. The first-prize heifer is a granddaughter of the two distinguished winners at the Society's

Shows, the Marquess of Exeter's "Telemachus 6th" and "Telemacina," who were both the offspring of the prize-bull "Telemachus;" and the second-winner, making apparently a very close contest with the Havering Park heifer, was Sir Henry Allsopp's beautiful "Duchess 123rd," the first female of her tribe — the "Duchess" tribe of Mr. Charles Colling and Mr. Bates—that has come into an English Showyard since 1861, when Colonel Gunter's "Duchess 77th" was the first-prize cow, "the twins" were first and highly commended in the two-year-old class, and a yearling took a first prize, at Leeds. The brilliant success of Mr. Bates at the opening Show at Oxford in 1839, and his further success in subsequent years, have brought his cattle, and especially this and his Oxford and Cambridge tribes, into prominent association with the history of the Society's annual Shows. The successful exhibition of a "Duchess" heifer, after the lapse of so many years, is therefore a noteworthy incident of the Shrewsbury Meeting. Mr. Toppin's "Warrior's Dream" (third prize), Mr. Palmer's "Baroness Hillhurst 3rd" (reserve), a daughter of his Reading first-prize bull "Caractacus," the Duke of Northumberland's "Sunflower," a daughter of "Sunshade" (highly commended in the Cow Class), Mr. Brierley's "Rosedale Snowflake" (a daughter of his first-prize cow), Mr. Hutchinson's "Lady Primrose," and Mr. George Ashburner's "Winsome Gem," all judicially noticed, added to the strength of the competition, and by their considerable merit enhanced the value of the success gained by the Havering and Hindlip heifers.

The Class for Pairs of Heifers was not well filled. There were seven entries, but only five came before the Judges, some of them in merely ordinary condition. For the exhibition of cattle in such condition we have occasionally loud demands, but compliance, somehow, is seldom rewarded with gracious notice.

Report of the Judges of Shorthorns.

The Judges of *Shorthorns* report that the numbers exhibited were not equal to those seen at many previous Shows, and the same may be said of the merits of the animals in several of the classes, more particularly with regard to the bulls.

Class 48 contained only four animals, two of which may be considered good types of a Shorthorn.

Class 49.—The Judges had little to do in this class; the first-prize animal taking a decided lead.

Class 50.—Not at all a strong class beyond the prize animals; they were not up to the usual standard.

Class 51.—A most creditable class.

Class 52.—A most satisfactory and interesting class, and one to which we would advise every encouragement to be given.

Class 53.—A most excellent class, every animal being noticed.

Class 54.—In this class there was a small competition; but there were some two or three splendid animals.

Class 55.—Only one entry put in an appearance, and these animals were of an indifferent character; and there was some hesitation as to giving them the first prize.

Class 56.—There was greater competition in this class, and many of the animals were of really good Shorthorn type.

Class 57.—There was also good competition in this class, and the prize animals were of a very promising character.

Class 58.—There were five entries in this class; but, beyond the prize animals, there was nothing of any especial merit.

We would wish to express our best thanks to the Steward of this department for the very able assistance he rendered us in the performance of our duties.

Charles Howard.
John Thompson.
John Wood.

Herefords.

A most satisfactory show of Herefords as regards the quality of the cattle, and so extensive that even the Shorthorn entries did not reach more than three-fourths of the number of the Hereford entries—the numbers being 144 Herefords, against 108 Shorthorns—proved decisively the abundance and excellence of what may be called the raw material, that is, the pure-bred Hereford stock of the country as it is kept in the ordinary course of farming. Until about the present time the capabilities of the breed have been exemplified chiefly by the magnificent steers and oxen, with occasionally a prime heifer or a marvellously massive cow at the Fat-stock Shows, and by animals specially prepared for a "starring" tour, to go the round of a few of the Shows of "breeding" cattle—the Royal Agricultural Society's, of course; the Bath and West of England always, and those county and local Shows where Herefords most do congregate. One after another, many of these "stars" have dropped out of our system, and the prompt supply of others of equal magnitude to appear in their stead is one of the great evidences of the ample resources that the Hereford breeders have at hand, and of the earnest determination of the breeders themselves to keep the Hereford creditably represented in the Showyard. Within the last five years the Hereford herds of England and Wales have been thinned, by large purchases for exportation to Canada, the United States, South America, Jamaica and other parts of the world. Ireland also has helped to meet the demand, and cattle purchased in the sister island have joined the selections in England and Wales at the port of shipment. Of many of these exports particulars have been published; but in some cases, either from indifference, or from desire on the part of buyer or seller to avoid publicity, no

properly authenticated information has been obtainable, so that the exact number of animals exported cannot be stated. An estimate of 3500 seems probably near the mark. Together with good stock Herefords in great number, many of the Show-yard "invincibles" crossed the Atlantic, and it was the presence of so many animals which are quite their peers, that struck the visitor at Shrewsbury as very remarkable.

When the Royal Agricultural Society selected Shrewsbury as the meeting-place for 1884, advantage was promptly taken of the choice of a town so favourably situated for the exhibition of Herefords to give due prominence to the Hereford feature of the Show. To the prizes offered by the Society, contributions were added by the Shropshire and West Midland Agricultural Society, the Hereford Herd-book Society, and a Committee of Hereford Breeders, and the number of Hereford Classes was extended to thirteen, or two more than the Shorthorns had. Ten classes of the two breeds run parallel: those for Aged Bulls, and Bulls of 1881–2–3; Cows: Three-year-old Cows or Heifers, Cows with Offspring, Heifers of 1882–3, and Pairs of Heifers of 1883. Then the Shorthorns have one class which the Herefords have not, that for the bull with his progeny, the prizes being offered by the Shorthorn Society; but, on the other hand, the Herefords have three classes which the Shorthorns have not—for Pairs of Bulls calved in 1883, Groups of four Heifers calved in 1882, and Groups of four Heifers calved in 1883. The numbers entered were: Class 59, Bulls of 1878–9–80, 5, all shown; Class 60, Bulls of 1881, 7, all shown; Class 61, Bulls of 1882, 10, one absent; Class 62, Bulls of 1883, 21, six absent; Class 63, Pairs of Bulls of 1883, 9, all shown; Class 64, Cows, 17, three absent; Class 65, Cows or Heifers of 1881, 6, two absent; Class 66, Cows with two Offspring, 3, all shown; Class 67, Heifers of 1882, 15, one absent; Class 68, Heifers of 1883, 21, two absent; Class 69, Groups of four Heifers of 1882, 5, one absent; Class 70, Groups of four Heifers of 1883, 12, two absent; and Pairs of Heifers calved in 1883, 13, one absent.

Mr. Aaron Rogers, of The Rodd, Kington, has the credit of breeding the first- and third-prize bulls in the Aged Class. His "Archibald," certainly the first full-aged show-bull of the day—"Lord Wilton" being over-aged for competition—is a grandson of "Grateful," the Champion bull at Kilburn. "Grateful" also was bred by him, and was a son of "Sir Thomas," and grandson of "Sir Benjamin," who was bred by Mr. Benjamin Rogers, the uncle of Mr. Aaron Rogers. "Archibald" is also descended from "Sir Thomas" through "Bismarck," in his sire's lineage. The influence of "Sir Benjamin" has been

traceable in the Showyards of the last twenty years to a wonderful extent; but it did not originate in him, his sire, "Sir David," having manifested that extraordinary impressiveness which "Sir Benjamin" and "Sir Thomas" inherited, those bulls happening to be from dams whose influence harmonised with, and tended to perpetuate, that of "Sir David." These three bulls have become the progenitors of a very large proportion of the best Herefords of the day, although the influence is not always strongest in the direct lines of inheritance, and not in all cases undiluted by active counter-influences. Another factor, and doubtlessly a powerful one, in the composition of "Archibald," is the "Royal" prize bull "Stanway," whose name appears in the pedigree of both sire and dam; and there is a dash also of the "Von Moltke" strain, well known in the Showyard not many years ago. Lord Bateman's third-prize bull "Charlton" is a son of "Grateful," from a dam by a son of "Stanway."

"Archibald" has, as "Grateful" had, wonderful fore-quarters, full and heavy, of immense depth, the line of dew-lap, running from the throat to the under part of the brisket, literally sweeping the grass as he walks. His top-line, backward from where the neck joins the shoulder, is very straight, and if it is a trifle lower at the rear than it should be to keep proportion with the fore-end, it falls off evenly; and perhaps if the hind-legs had less weight of flesh than they have to support, they would raise the hind-quarters just enough to make the proportion true. His head is not quite so pleasant to look upon as "Grateful's," but it has a character of its own, and is easily remembered and recognised.

Excellent as "Archibald" is in nearly all the points which constitute a first-rate Show bull, some tastes would give the preference as a stock-sire to the Earl of Coventry's "Fisherman," the second-prize bull, whose son, Mr. J. S. Gibbons' "Tinker," bred at Croome Court, has the reserved number. Both these bulls have much masculine bigness of muscle, and "Tinker," a good lengthy bull, in not very high condition, has time and room to develop still more a resemblance, already recognisable, to his noble-looking sire. "Fisherman," not so nearly perfect as "Archibald," according to the requirements of the Show-ring, fills the eye grandly, as he is a large bull of immense substance, yet moves about as if by no means over-burdened by his flesh. As a younger bull he had, to a degree which the more generous development of maturer age somewhat lessens, the smoothly even surface so difficult to obtain in combination with great size; the only variation from the almost perfect straightness of the upper outline was where the mus-

cular crest formed a segment of a circle between head and shoulder, with a gentle slope off, over the shoulder-top, into the dead level of the back; and the side-lines, as he advanced or retreated, were round but not too sudden in the curve, showing sufficient depth as well as expansion of rib. Now, although nowhere abruptly patchy, he shows the gentle upheavals incident to the age of six years in a bull of his flesh-making capabilities: his near presence is more imposing than it was three years ago, but his symmetry requires a longer focal distance to be fairly judged. "Fisherman," by the direct male line, comes straight from "Walford," and is only fourth in descent from him, through "Franky," the famous sire of prize-oxen, Mr. Philip Turner's "Jupiter," and Mr. T. Rogers's "Conservator;" through "Jupiter's" dam and her sire, "Bolingbroke," he is a descendant of "Sir Benjamin;" and through two other tributaries he has the blood of "Sir Benjamin's" sire, "Sir David." Several other strains, long-established and of excellent reputation, intermingle with these.

The level outlines so remarkable in "Fisherman" when about the same age, are reproduced in the first-prize bull of 1881, "Good Boy," bred and exhibited by the Earl of Coventry; sire, "Fisherman," dam, "Giantess," bred by Mr. Tudge, by "Sir Roger." "Good Boy" has the "upstanding" character of his dam, and she "grew down to her legs,' *i.e.*, deepened in body, as she advanced in life. He may do so too. Mr. Arkwright's "Rose Cross" (the second winner) and Mr. W. Tudge's "Prince Rose" (third prize) are respectively son and grandson of "Rosebud," the winner of at least two first prizes at the Royal Agricultural Society's Shows; and "Conjuror," the sire of Mr. Arkwright's bull, has also won the Society's first honours.

Mr. A. E. Hughes' "Washington," whose deep flesh quivers a little too much under the hand, indicating more outside fat than is necessary or desirable in a stock-bull, but whose surface is perfectly level (no sack of meal could be more so), has beautiful symmetry and character, and, as a son of the celebrated "Rudolph" (now in America), represents a most illustrious paternal line. A good son of "Lord Wilton," "Albany," exhibited by the breeder of "Archibald," and Mr. R. W. Bridgwater's thick-fleshed, robust-looking "Benefactor," of the longish, low-built stamp, are the other winners in the class. Two more of the sons of "Lord Wilton"—"Lord Grosvenor," from Stocktonbury, and "Hotspur," bred at Stocktonbury, but now the property of Mr. H. R. Hall, of Holme Lacey; also "Consul," bred by Mr. A. Rogers, and shown by the Earl of

Coventry, and "Prince," bred and exhibited by Mr. Duckham, M.P., commanded favourable notice.

An excellent class of last year's Bulls had at its head Mr. Taylor's "Maidstone," by a son of "Lord Wilton," from a daughter of the Society's first-prize bull "Tredegar," combining size and quality, and from present appearances likely to make a name in the future. He met the select of his own age in the Hereford-breeding district, and conquered; and at the Essex County Society's Show was pitted against "Archibald," and in that unequal contest placed second; but his day is to come, unless disappointing change (always possible in a yearling of such vigorous growth) should falsify the promise of his present appearance.

The influence of "Horace," one of the most remarkable Hereford sires of recent years, will be historically classed with that of "Sir David," and with "Walford's" influence. Its power is in some measure exemplified in the second-prize bull in this class, whose not very pleasant name seems intended as an index to the names of his maternal grandsire and his own sire. "Anxiety Arthur" is a son of "President Arthur," whose sire and dam's sire were both sons of "Horace," and his dam was by "Anxiety," first in his class at Liverpool, and again at Kilburn. There is "President Arthur's" unmistakable impress in the thick, square, loggy body, and "Horace," his mark, in the layer of lean-flesh along the back.

Mr. W. Tudge's "Leinthall," a very promising son of "Auctioneer" and "Roseleaf," makes a good third, and is closely related to the second- and third-prize bulls in the next class but one preceding. His dam, a handsome and heavy-fleshed cow, appeared in the Dairy Class, and looked as if she can fill the pail as well as she can pack on the beef. Mr. Hughes's "Sergeant-Major," by "Rudolph," Mr. Arkwright's "Chesterfield," of the noted family of "Ivington Lass," Mr. Rees Keene's "Revival," Mr. Nott's "Conqueror," and about half-a-dozen other bulls in this class did really great credit to the breed, for a breed is in a good way when it can show so many young bulls of high character.

The two bulls of the first-prize pair, calved in 1883, Mr. Arkwright's "Hampton Court" and "Gambit," are both sons of his prize bull "Conjuror," from cows by "Ivington Boy." The second winners, "General Gordon" and "Hamlet," bred by the late Mr. T. J. Carwardine, and exhibited by his executors, are sons of "Sir Bartle Frere," the well-known young bull sold at a very high price for exportation, after great success in the Showyard. "Sir Bartle Frere" is a son of "Lord Wilton."

The third-prize pair, "Clinker 3rd and 4th," bred and exhibited by Mr. Hill, of Felhampton Court, are sons of "Merry Monarch," a descendant of the old Downton Castle Herefords of Mr. Knight, famous at the end of the last and early in the present century, through the herds of Mr. Theophilus Salwey, of Ashley Moor, and Lord Berwick. The power of a good old strain of blood has been remarkably shown in the excellent and uniform character of "Merry Monarch's" progeny, and the two young bulls at Shrewsbury, from dams of Messrs. Green's "Cherry" family, are fair specimens, not above the average, of his stock.

In a fine Class of Cows the Earl of Coventry exhibited two, and gained the first prize and a commendation. The first-prize cow, "Golden Treasure," bred at Croome Court, is the offspring of "Maréchal Niel" and "Giantess" (the dam of "Good Boy," the first-prize bull in Class 60), both bred by the late Mr. Tudge, of Adforton, a breeder who has certainly left the impress of his mind upon the Herefords representing the Adforton herd and its offshoots. Among the indirect descendants of that herd may be included the progeny of "Regulus," "Lord Wilton," and other sires whose names must occupy prominent places in Hereford history, and whose blood is already circulating extensively in the leading herds of this country, the colonies, and the United States of America. "Golden Treasure," wide, deep, and immensely massive, showing a trifle too much white, is a lower built and more compact cow than her dam, "Giantess," with whom and her half-brother, "Good Boy," she was last year one of the first-prize family group at York. Through her sire she is a grand-daughter of the "Royal" first-prize cow "Rosebud," the dam of Mr. Arkwright's second, and grand-dam of Mr. W. Tudge's third-prize bulls in the same class this year with "Good Boy," who, as we have seen, took the first place. The other cow from the Croome Court herd, "Rarity 14th," bred by Mr. R. L. Burton, of Longner Hall, belongs to a fine old family in the Cronkhill (Lord Berwick's) herd, dispersed in 1861, and is descended from very celebrated winners in former years. Although not a perfect show-cow, having "gone to pieces," as the term is, or become "patchy" in her after-parts, she has a girth which reminds us of her ancestor, "Attringham," being, as all Herefords should be (and Hereford breeders likewise, in their estimate of each other's labours), great through the heart. The shoulder is neatly laid, and the out-shoulder big, a point in itself surely advantageous, if not spoiled by the too frequently accompanying fault of bareness immediately before the out-shoulder, and if the fore-rib, as in this case, is sufficiently expanded and sufficiently

covered with flesh to make up a good level behind it. Mr. Arkwright's "Pearl 3rd," the second-prize cow, although not in high Showyard condition, has an immense grasp of loin; nay, when we come to look lengthwise down her back, we may say a pair of loins, for the rolls of flesh have a clear line of division over the spine, a relative rather than a positive deficiency, from superabundance, if that may be, at the sides. Mr. W. H. Taylor's "Modesty," the first-prize cow at York, has the third place this year; his "Adelaide," second at York, is here highly commended; and Mr. R. W. Hall's "Lovely 1st," the first winner with her twin heifers at Reading, and second with two of her offspring at York, has here the reserved number.

The twin daughters of "Lovely 1st," "Dorothea" and "Theodora," by "Lord Wilton," were the first and second winners in the Class of Younger Cows or Heifers. They show "Lord Wilton's" impress very distinctly, and retain much of that close resemblance to each other that has made the task of distinguishing them a puzzle ever since they began their Showyard career. The number in the class being short, only four competing, the offer of the third prize became void, according to the conditions; but the Judges specially recommended the grant of that prize to Mr. Myddleton's "Lady Mary 5th," a really good three-year-old cow in-milk, and apparently in full health, but unfortunately found dead on the morning of the day after her return from the Show.

One of the most generally observed features of the Hereford Classes, and a common subject of conversation in the Showyard, was the excellence of Mr. H. W. Taylor's first-prize group in Class 66, for Cows and their Offspring, the prescribed number being two with each dam. The cow was "Rosamond," a nearly seven-year-old cow, of beautiful proportions throughout, and of most generous flesh-growth, in colour a lightish red ground, covered with dappling of a deeper shade, and of course with the true Hereford white points. She was only third in single competition in last year's class of cows, her owner's "Modesty" and "Adelaide" then beating her; but she was this year in general estimation before both of them, although, being in the family class, and they again entered in the Class of Single Cows, she did not come into actual competition with them again. Her heifer calf "Rosette," by "Franklin" ("Lord Wilton's" son), is one of those rare young animals upon which very high hopes of future success may be placed in reasonably strong expectation of their fulfilment. "Rosette"—life, health, and the usual Showle Court skill in management granted—can scarcely fail to be, another year, a heifer that must meet a *very* good one before she can be fairly beaten. Mr. H. R. Hall's group made good

second-winners. The brothers Messrs. Hall, of Ashton and Holme Lacey, are both bringing out, very creditably indeed, the descendants of the old Ashton herd, bred on the farm for more than a century, and divided between them when their father retired from business. They have used, and are now using, some excellent bulls, with such results as were seen in various classes at Shrewsbury.

Great size for her age, and that robust and vigorous growth which promises great size at maturity, yet without uneven development anywhere; plenty of flesh, but so evenly distributed that no one point is remarkable; and, for any time of the year, especially for July, an extraordinary coat of thick, wavy hair, of the rich red colour that pleases the American visitor, are the most noticeable characteristics of Mr. A. E. Hughes's "Sunflower," the first-prize two-year-old heifer. Mr. Rees Keene's really pretty heifer, "Jeffrey 8th," the second winner, not on so large a scale, but whose weight would exceed that of many a bigger-looking animal, is a good specimen of the stock of his "Reward," a bull of much character, first in his class at Derby in 1881. The selection for third prize was a good and bold one, doing justice to merit in the rough. Mr. Powell's "Vinca" does not stand an example of the results of high education, and it was contrary to custom that great accomplishments in refined corpulence were passed by in favour of her honest worth. The award took many outsiders, and perhaps some exhibitors, by surprise.

The excellence of stock of "Franklin" (own brother to "Conqueror," purchased for the herd of Her Majesty the Queen from his breeder, the late Mr. Carwardine), has been already illustrated in Mr. Taylor's "Rosette," in Class 66. In Class 68, Heifers of 1883, Mr. Taylor exhibited another supremely beautiful specimen of the same sire's stock, "Vanity 7th," the first-winner. The style and quality of these heifers would seem to mark "Lord Wilton's" son, "Franklin," as a sire whose influence is perhaps not less powerful for good than that of "Lord Wilton" himself. The stock of the Earl of Coventry's bull, "Fisherman," represented in this class by the second winner, must be regarded as supplying ample evidence of that sire's value also; not, possibly, like "Horace," for example, whose salient characteristics are so strongly impressed upon his offspring that they reappear in successive generations, but as a bull that may be safely trusted to stand at the head of a herd of good and judiciously assorted cows. Mr. Arkwright's third winner, "Pearl 5th," a daughter of "Conjuror," and of "Pearl 3rd," the second-prize cow in Class 64, is a remarkably showy yearling, with

plenty of material about her for making a good massive cow; and Mr. Robinson's "Princess 5th," composed of "Horace" and "Provost," through her sire, and of "Regulus," "Sir Thomas" and "Sir Benjamin," through her dam, well deserved the fourth prize in a large and an exceedingly good class.

We now come to a remarkable feature of the Show, the exhibition of Heifers of 1882 and 1883 in groups of four, in Classes 69 and 70. Both were good classes, if we except one entry of really inferior animals, quite unfit for exhibition, in each class, and one other poorish lot of four in the Class of Younger Heifers, which, nevertheless, was the better and the larger class. In the other class, the executors of the late Mr. Carwardine exhibited the first winners, "Henrietta," "Rosa," "Luna," and "Althea," four handsome and massive heifers, all by "Lord Wilton." Mr. Boughton-Knight, of Downton Castle, (the home of the "Knight's Greys," in the last and early part of the present century), exhibited the second winners, wide-built, thick-fleshed heifers, three by "Downton Grand Duke," and one by "Auctioneer;" but the prime beauties were among the Younger Heifers—Mr. A. P. Turner's "Kathleen," "Hilda," "Violet," and "Sibyl," all by "The Grove 3rd," the bull sold at The Leen, last year, publicly, for 810 guineas, and exported to America. In "The Grove 3rd," the "Horace" and "Sir Thomas" strains are united. The three heifers are wonderfully alike in character, although one is just a little less wide and substantial than any one of her three companions. There were certainly in this class, putting aside the inferior lots, 28 remarkably fine heifers standing in the ring together. Mr. Price's "Sprightly," "Gipsy Girl," "Dainty," and "Pearl," full of "Horace," and such thick, good heifers as the Court House herd can always turn out, took the second prize; Mr. Robinson's "Damsel 12th," (not "7th," as in the Catalogue) "Cherry 23rd," "Red Spark 4th," and "Woodmaid 6th," doing credit to the "Horace," "Regulus," "Lord Wilton," and one or two other good strains, including that of Cronkhill, stood next in honour. Mr. Moore's "Lady Norma 5th," "Bright Pansy 1st," "Bright Ethel 6th," and "Merry Agnes 6th," all by "Bredwardine," and wearing the brand of their grandsire, "Horace," were fourth on the prize-list; and the reserved number gave credit to a fine lot of heifers, bred and exhibited by the Earl of Coventry. Mr. Smith and Mr. Minton had each a good lot of heifers in the ring, those from Gattertop being specimens of the stock of "Zulu Chief," and those from Montford-bridge all by "Assistant," a half brother of "Archibald."

One more good class closes the list of Herefords—Class 71,

Pairs of Heifers of 1883. Mr. Price sent the best pair into the ring; but the competition with the Stocktonbury pair, by one of Mr. Price's bulls, was very close.

Judges' Report on Herefords.

CLASS 59. *Aged Bulls.*—First prize, No. 514, is the well-known "Archibald," which appears in the very superior form as regards great substance, symmetry, and level flesh, for which he has always been remarkable; second prize, No. 512, "Fisherman," a very large bull of excellent character; third prize, No, 513, a useful animal.

CLASS 60.—First prize, No. 516, long and straight-topped and level form, but a shade leggy; second prize, No. 517, a good one, but a trifle defective in the shoulders; third prize, No. 520, a fine animal, but not perfect in the rump.

CLASS 61.—First prize, No. 524, handsome, with good character, substance, and very level flesh; second prize, No. 527, stylish, but somewhat uneven in his back; third prize, No. 529, great substance, and deep flesh.

CLASS 62.—First prize, No. 541, a very large and grand animal; second prize, No. 537, a very thick animal, but slightly defective in the hind-quarters; third prize, No. 548, a good style of animal. There are several others in this class of great promise.

CLASS 63.—First prize, No. 554, a well-matched pair of excellent character and flesh; second prize, No. 556, one superior, the other one a moderate animal; third prize, No. 562, very large and useful.

CLASS 64.—First prize, No. 564, the well-known "Golden Treasure," is in grand form, and well entitled to her position; second prize, No. 568, a fine cow in business form, having a capital calf at foot; third prize, No. 570, a grand one, but advanced in years, and now patchy in the hind-quarters. This is a good class.

CLASS 65.—First prize, No. 581, a short-legged one, good, but not quite right in her rumps; second prize, No. 580, very similar to the winner; No. 585, a useful heifer, and recommended for third prize.

CLASS 66.—First prize, No. 586, a perfect specimen of her race, with a very superior calf at foot, and a very straight and useful two-year-old bull; second prize, No. 587, two good and level cows, and the third a good one.

CLASS 67.—First prize, No. 590, a straight and good one, now rather high on the leg; second prize, No. 591, a very thick and beautiful heifer, but not perfect in hind-quarter; third prize, No. 596, backward in condition, but of great promise.

CLASS 68.—First prize, No. 612, quite a gem; second prize, No. 604, very large and good; third prize, No. 607, stylish, with deep flesh; fourth prize, No. 614, level, and a compact one. This is a beautiful class.

CLASS 69.—First prize, No. 625, four heifers of size, substance, and good character; second prize, No. 629, a useful lot.

CLASS 70.—First prize, No. 632, four remarkably handsome and well-matched ones. The winners of second, third, and fourth prizes were all of great excellence; and the reserved, No. 630, were very fine heifers. This is another fine class.

CLASS 71.—First prize, No. 651; second prize, No. 647; third prize, No. 648. This is a class possessing great merit, and very little difference between first- and second-prize winners.

We consider the exhibition of these cattle extremely meritorious, both as regards number and excellence of quality; and this is surprising when we

remember the large number of superior animals which have been exported to America and elsewhere during the last five years.

Henry Haywood.
Adam Lee.
R. S. Fetherstonhaugh.

Devons.

The Devon Classes, very full of merit, presented considerable difficulties in the course of judging. In one or two of the classes, animals whose Showyard history has been brilliant were beginning to feel the effects of wear and tear, and might be likened to fruit just over-ripe, or flowers full-blown and on the turn towards decay. If the Judges, who possibly have seen the animals before, and know them, or even if that is not the case, cannot fail to observe that they are evidently seasoned Show-goers, give prizes to previous winners, all is considered right; although the Judges who first discovered the merits of those animals and gave them their earliest honours were perhaps freely abused for their awards; but if the "plum" of a former Show, now dead-ripe, is cast out or taken as second, third, or fourth choice, what an outcry is raised against the Judges! *

In the first Class (72), 6 entries, 2 absent, the competition was between the brothers, Mr. Perry's "Benedict" and "Bravo," and a couple of half-brothers, "Plum Pudding" and "Sir Watkin," from the Tregothnan herd. All these were at York; but there "Bravo" and "Sir Watkin," the former first, the latter passed over, were in the younger class, while "Plum Pudding," reserve number, and "Benedict," commended, were in the same class as upon this occasion. "Druid," the sire of "Benedict" and "Bravo," was the first-prize bull last year. The elder brother is this year selected for the first, the younger for the second prize; "Plum Pudding" has the reserve and a high

* The Devon Judges at Shrewsbury did not escape the harmless attacks of anonymous critics. Comments condemnatory of some of their awards, circulated on the Showground, found their way into print. It may be my misfortune to differ from critics who hold themselves competent to pass unmeasured censure upon the awards of Judges selected by the Royal Agricultural Society of England; but having watched the decisions with considerable attention, I wish to express my belief that they are intelligible to any one who understands cattle, having bred them, and who has made himself acquainted with the Devon type. That equally competent Judges might reverse some of the awards, is quite likely; but I would maintain that the reasons of the Judges were obvious enough to practical and well-instructed men, and indicated both competency and care on the part of the Judges, with whom I am not personally acquainted; nor did I hold conference with them, or any one of them, privately or officially.—W. H.

commendation; and "Sirloin," whose appearance was injured by a slight cutaneous disorder, is again left unnoticed.

Bulls of 1882: 3 entries, all shown. "The Peer," bred and exhibited by Mr. Herbert Farthing, repeated his York victory. Mr. A. C. Skinner's "Lord Cutsey 2nd" and Mr. Howse's "Master Frank" are both good bulls, but not his peers. No one could pretend to find fault with this award.

Bulls of 1883: 9 entries, one absent. First, Mr. Walter's "Young English Gentleman," *very* young, a September calf only, competing against much older and larger animals. The Judges evidently saw "a good bull in him" to be developed some day, and some outsiders thought they could see as much themselves; so Sir W. Williams's "Candy" got only the second prize. He is a good and useful-looking bull, but had a touch of ring-worm, cured, doubtless, long before this Report comes to light. The circumstance is mentioned, because the disfigurement is so often allowed to extend upon animals otherwise carefully treated, and to infect a whole herd and the herdsman also, and may be so very easily stopped at the first outbreak. Mr. H. Farthing's "Daisy's Bull" had the reserve; Mr. W. Rolles Fryer's "Pine Apple" a commendation; and with these noticed animals were others of good reputation—Mr. Bradbeer's "Heanton," Mr. Perry's "Draughtsman" (a son of "Benedict"), and Mr. Northey's "Actor" and "Lord Underwood."

A good Class of Cows contained 8 entries, one afterwards withdrawn. All the seven in the Catalogue cried "Here" to the muster-roll on the morning of the judging day. Mr. Howse's "Daisy 4th," second at York, missing her last year's rival (Sir W. Williams's "Rosebud"), stepped into the first place, and Mr. Walter's two cows, "Gipsy Lass" and "Famous" (the latter half-sister to Sir W. Williams's prize bull "Candy"), took the second prize and reserved place. Mr. A. C. Skinner exhibited his "Myrtle 7th," the first-prize cow at York, here highly commended, and "Sally," third by special recommendation of the Judges in the Three-year-old Class at York, here passed over individually, but partaking of the compliment which the Judges pay to the class collectively.

In the Three-year-old Cow or Heifer Class, Mr. A. C. Skinner's splendid young cow, "Moss Rose 8th," first at York, is again first; and Mr. W. Rolles Fryer's "Mignonette" once more, as last year, holds the second place; Mr. Perry's "Diadem 2nd" (by "Druid") having the reserved number. These were the only entries. The two last Classes, 77 and 78, Heifers of 1882 and 1883, formed excellent classes, the former containing 9 entries, 8 shown; the latter 11 entries, 7 shown. In both classes the

heifers of Sir W. Williams were first, those of Mr. W. Rolles Fryer second. The elder first-prize heifer, "Frolicsome," is of the ever-famous "Temptress" family, of Flitton, descended from the late Mr. James Davy's Battersea International Gold Medal cow, and is a beautiful heifer of much style and finely-moulded form. The younger first-winner from the same herd, "Flame," a good yearling, has a Flitton sire and a dam of the Stowey Court strain, being of the same family, that of "Famous," to which the bull "Candy," in Class 74, and Mr. Walter's cow, in Class 75, belong. The reserved-number heifer in the Older Class, Sir W. Williams's "Fashion," was the York first-prize yearling, and is of the "Temptress" family. The animal holding the same place among the heifers of last year is from the Windsor herd.

Report of the Judges of Devon Cattle.

Class 72.—Good. Nos. 659 and 660, own brothers, were very good specimens, and possessed fine quality. The reserved bull lacked firmness of flesh, apparently from overshowing.

Class 73.—No. 663, a handsome young bull, fully deserving of the first prize.

Class 74.—No. 664; very promising, and will doubtless appear again in the prize list.

Class 75.—No. 679, very good cow of fine breeding. Class so good, third prize asked for.

Class 76.—No. 682, one of the best animals of the breed exhibited.

Class 77.—Good. No. 688, a very promising heifer.

Class 78.—Equally good. The prize heifers No. 697 and No. 699 look growing into good cows.

We are pleased to note a decided improvement in the general quality and breeding of the Devons. This is especially pleasing, as the Show is not held in the home of the breed.

Stephen Bailey.
Thomas Fulcher.
George Napper.

Sussex.

This is a breed which should assert itself in the competition of beef-making breeds for American patronage. It can clear up the coarsest pasturage, bear hardships, walk any distance, and feed to great weight. Its uniform character, strongly transmitted to the progeny of Sussex bulls crossing other breeds, is also in its favour.

The classes show a little variation from the arrangement of last year. At York the first class was for Bulls of 1877–8–9. This year it is for Bulls of 1878–9–80–81, bringing one year more within its limits, making the next class for Bulls of 1882, instead of Bulls of 1881, and so making room, further, for a class of last year's Bulls, which had no corresponding class at

York. By this alteration, the breed has the advantage of showing its capabilities of growth in an earlier stage of life. The female classes are the same as last year's, with of course the one year's difference in date, and are for Cows calved on or before 1880, Cows or Heifers of 1881, Heifers of 1882, and Heifers of 1883. The numbers are—Aged Bulls, 5 entries, two absent; the next class, 7 entries, three absent; and the next, 4, one absent. A withdrawn entry, No. 720, belongs either to this class or to the Cows, which in the Catalogue have 5 entries, one absent. The three Younger Cows or Heifers were all on the ground; two of seven heifers of 1882 were absent, but one was a cancelled entry; and only one heifer of 1883 failed to appear in her place.

The first-prize bull in Class 79, Messrs. E. and A. Stanford's "Reading," is the son of a bull which occupied the same position at Derby, Reading, and York; and his grand-dam daughter of a bull which had the same place at Bristol; while this year's winner was himself first as a two-year-old at York. He is a bull of good flesh-points, remarkably well packed behind the hips, with also heavy thighs, and a deep, hanging flank. Mr. T. A. Vickress' second-prize bull is a son of "Berry," a neatly-built and not very large bull, but one that has made an extraordinary mark wherever he has gone, giving that equality of surface which some of the Sussex cattle wanted for exhibition purposes, without destroying the robust character of the breed. "Shirley" affords an example of this in the wonderful amount of flesh so evenly laid over the shoulder-blades, shoulder-point, neck-vein, and up the neck itself. Pass the hand lightly over those parts, and nothing comes in its way, the surface being so smooth (excepting an ample growth of hair); but let practised fingers play upon the surface, and the depth and solidity of the covering of the frame are perceived. The bull has a well-coupled and well-covered middle, but goes off comparatively light in the hind-quarters. He has made an advance since last year, when he had only the reserve in his class. The reserve and a high commendation were awarded to Mr. Agate's "Frankenstein 3rd," as also last year. Messrs. Heasman's strain comes to the front in Mr. Agate's "General Roberts," the first-prize two-year-old, who is a very creditable example of heavy development at an early age. Another son of the Messrs. E. and A. Stanford's "Goldsmith" is second in the class, and the third, "Prince Rufus," from the well-known prize-winning Lythe Hill herd in Surrey, is in the act of growing too rapidly to be presentable in true Showyard form. The Yearling Bulls did not come out so showy-looking as their elders, but had plenty of frame for age.

A beautiful cow, shown just as a cow looks her best, although

not the best for her chance of winning, took the first prize in Class 82. "Dorset 8th" (that is her name) belongs to, and was bred by, Messrs. E. and A. Stanford. She is a daughter of their "Goldsmith," three times first-prize aged bull at the Society's Shows, and from "Dorset 2nd," their first-prize cow at Derby, whose sire was "Dorchester," their first-prize aged bull at Bristol. The Judges made some allowance for the lightish thigh of "Dorset 8th," on the ground that she was suckling her calf, and consequently in reduced condition, and this is, to a certain extent, available as an excuse; but it is questionable whether the fault would not be in the thigh in any circumstances; her dam's one most noticeable fault was there. The *tout ensemble* is graceful, and a finely-shaped and feminine head, with sufficiently prominent eyes, horns openly set, and growing in big sickle curves round to the front, a clean cut out but not too light neck, nicely pointed breast, and true upper and lower outlines of body, widely-sprung ribs, and neatly finished hind-quarters, make her an attractive-looking animal, whose excellence does not seem less when examined in detail. The Judges in their Report seem almost more partial to the second-prize cow than to the first, and to have been unable to overlook the patchy part; but, however this may have been, "Marygold 4th" (reserved and highly commended at York) well merits the praise they give her.

A reversal of position occurs in the next class, Mr. Agate's "Young Gentle 2nd," third at York, now taking the first place, and Mr. J. S. Hodgson's "Peace 2nd," first at York, the second place; Captain Green's "Bertha" advances from a commendation to the reserve. Class 84, Heifers of 1882, has a reversal in every award. Mr. Vickress' "Activity," first at York, is here only commended; his "Confidence," second at York, is here first; Mr. J. S. Hodgson's "Ladybird 1st," third at York, here has the reserve; and Mr. Agate's "Daisy 5th," highly commended at York, here second. These alterations may arise partly from differences of taste and judgment, but the changes which young animals undergo in twelve months are quite sufficient to account for reversals of the kind. The best yearling is not always the best two-year-old. The Judges have so fully described the principal animals in these classes, that no further descriptive remarks are necessary, and their comments in some cases indicate the reasons which influenced them in making their awards. The youngest class of Heifers was about the best of all the Sussex Classes, showing very good size and development at an early age. This is a desideratum which the Sussex cattle can meet, and it is fortunate for their reputation that the younger stock exhibited at Shrewsbury were so forward and so good.

Report of the Judges of Sussex Cattle.

Considering the distance at which the "Royal" Show was held from the native home of the large red breed of cattle, they were well represented from the herds of the principal breeders, although rather short in numbers.

In Class 79, No. 708 was placed first, a grand, massive animal, with good head and capital touch from the well-known Eatons herd; second prize, No. 704, was one of the best fore-quarter bulls of the breed that has come before the public this year, but which is very much wanting in his hind-quarter; the reserve and highly commended, No. 707, was well worthy of the notice.

Class 80.—No. 714, first prize, was a massive bull, with a great deal of flesh and substance, which is a great point in these days of early maturity. The second prize went to No. 710, not quite as he should be in the rumps, and a little harsh in the touch; reserve number, 711, was a fine animal, but flat ribbed, but looks likely to make a large animal when older.

Class 81.—First prize, No. 718, had a nice head and colour, but was rather leggy; second prize, No. 719, was a fair useful animal.

Class 82.—No. 725, first prize, was a very nice cow, with grand back and good touch, but a little wanting in the thighs; she had a calf by her side, so did not show to the best advantage; second prize, No. 721, was a grand cow, showing a great deal of the old Sussex type, but rather patchy in the rumps; both of these animals were bred by the Messrs. E. and A. Stanford, of Eatons.

Class 83.—First prize, No. 728, was a cow of great substance, very close to the ground, and looks like a wonderful milker for the breed, rather light in colour; second prize, No. 726, very good spread and colour, but very short from the hip to the rump.

Class 84.—First prize, No. 730, a fine massive heifer coming from the Slinfold Herd, which, although in its infancy, has already shown some good and promising animals; second prize, No. 735, a very nice heifer, but wants a little more age to furnish; reserve, No. 732, was a nice animal, but leggy.

Class 85.—No. 744 and No. 743 were placed first and second, two very nice heifers belonging to the same exhibitor, Mr. A. Agate, of Broom Hall, Horsham; reserve and highly commended, No. 742, was a nice heifer, hardly spread enough, and not as good in the touch as one could wish. This class was well represented, and deserved commendation throughout.

George Napper.
Stephen Bailey.
Thomas Fulcher.

Red Polled.

The old and cumbrous name of Norfolk and Suffolk Polled having been dropped since last year's Show, this remarkable breed of Eastern England made its first appearance at the national Show under its new name of Red Polled. Instead of the four classes, two of Bulls, one of Cows and Heifers from the usual breeding age upwards, and one of Younger Heifers, as at York, where the entries numbered 34, it had this year seven classes, containing 44 entries. The changes were effected thus: the first class of Bulls, comprising animals of the 2nd, 3rd, 4th, 5th and 6th year before the year of exhibition, was altered

to one for animals of the 3rd, 4th, 5th and 6th years, the 2nd year forming the limits of an additional class, and the Yearling Bulls stand the same as before. From the heading ot the first class for females, the words "or heifer" are omitted, and the ages allowed range from an unlimited "previously to," to any time within, the fourth year before the year of exhibition. A class for Cows or Heifers of the third year is thus got out of the old class; the class of Heifers of the second year remains as before, and a new class for Heifers of last year is introduced.

Some very good and useful-looking bulls, level and thick-fleshed, of rich colour, with the style which only carefully-bred animals can possess, competed in the three classes. The York first-winner, here No. 824, was simply passed over, affording the city critics an irresistible opportunity of descanting upon judicial liability to egregious mistake; but if townsmen who come to Shows to put country Judges right could suspect the meaning of an enlargement upon the left side of the face, which had no duplicate on the right side, they might hesitate to express themselves so freely as they do. Next to Mr. Taylor's "Passion," the York reserve, Mr. R. H. Mason's "Starston Duke" (also bred by Mr. Taylor) takes rank on the prize-list. The latter, a deep-sided, thick bull, with heavy rounded thighs, is closely related to the first-winner, the sire of both being the same, and the dam of "Passion" the grand-dam of "Starston Duke." Mr. Tyssen-Amhurst's "Cortes," second at Reading and commended at York, has the reserve and a high commendation.

Mr. Lofft's intensely deep-red "Broadhead," Mr. Haggard's "Sand Boy," who maintains his York position as second, and Lord Hastings' "Rupert," are the noticeable bulls in the second class; but the bull of the really highest style and character, the beau-ideal of a thorough-bred animal, is Mr. R. H. Mason's "Napoleon," whose merit (although particulars of which the butcher can take no cognizance go to make a most attractive appearance) consists mainly in properties which the most practical men can appreciate. There is a frame of ample size, not over-grown, truly moulded to the most perfect proportion of each part to the whole; straight limbs are set in the right places, and the joints are most beautifully turned, the hocks are especially straight and neat; and the short tapering of the ends of the massive thighs to the bocks, with flesh as far as flesh can go, and then no lumber, but a nice clean joint, make quite a pattern of refined form. The touch discovers a rich layer of lean-flesh spread everywhere evenly, and the hair is of the richest red, deep in colour, but not blackened. The head is gay

and full of life; the neck (a most expressive feature of a bull, if the term may be allowed, as his way of using it tells his character) is sufficiently substantial without coarseness, and extra arched, with a bridling, sideway half-turn of the head on the approach of a stranger. Vigorous life, not vice, appears in this instant consciousness of notice.

The Judges, whose remarks express the opinion of at least one expert in the standard of points for this breed, refer to the colours of three of the exhibited animals in terms to which more than a passing reference is needless.

Mr. Colman's "Dolly," first at Derby and York, and Mr. Taylor's "Buxom," third at York, were first and second in the Class of Older Cows. In the next Class, Cows or Heifers of 1881, Mr. Hammond's "Davy 37th and 38th," first and second in the Heifer Class at York, were again in the same positions. The first is quite a model in form, wonderfully good over shoulder and crops and round the girth, and the second also a fine young cow. Both might be somewhat more neatly finished in the hind-quarters, and the colours might have more of the rich and characteristic hue of the breed; but they are fine animals, without reference to breed or colour. Mr. Colman's "Rosalie," a smart "King Charles" heifer, in the Two-year-old Class; Lord Hastings' "Ruperta," a nine-months-old calf, in the Class of last year's Heifers; and Mr. Tyssen-Amhurst's "Didlington Davy" among the Elder, and "Poppinette V. 43" among the Younger Heifers, are the prize-winning and most remarkable animals in the two last classes.

Report of the Judges of Red Polled Cattle.

Red Polled Cattle (hitherto known as Norfolk and Suffolk Polled), although not so numerously represented as at the local Exhibitions in the Eastern Counties, made a creditable show:—

Class 97.—No. 825, first prize, combines massive proportions with good looks and stylish carriage; No. 819, second prize, same breeder and sire, also a thick-fleshed, good bull; No. 824 might possibly have received recognition at our hands, but for the presence of a large tumour on the face.

Class 98.—No. 827, first prize, a broad animal on short legs, has hair and colour not unlike a Galloway; No. 829, second prize, straight and lengthy, but too high on the leg.

Class 99.—No. 834, first prize, a very promising young animal, about the best in the three classes for bulls; No. 832, second prize, and No. 833, from the same breeder as first-prize bull in previous class, present appearances in hair and colour indicative of Scotch blood, No. 833 having a brindled skin.

Class 100.—No. 843, first prize, a short-legged massive cow; No. 844, second prize, looks like a good milker.

Class 101.—Nos. 848–9 take the two prizes, a pair of grand heifers, but lacking the true characteristics of the breed; No. 847, the only other exhibit in the class, is more like what a Red Polled should be, but is hard and harsh under the hand.

Class 102.—No. 851, first prize, is a very sweet little heifer, lengthy and good, with a tendency to patchiness.

Class 103.—No. 862, first prize, long, low, and straight; No. 859, second prize, nice form, plain at rumps end.

Thomas Fulcher.
George Napper.
Stephen Bailey.

Longhorns, Welsh and Dairy Cattle.

The one heading for breeds so distinct as the Welsh and the old Longhorn, and for the miscellaneous cattle in the Dairy stock Classes, is adopted, as already explained, for the convenience of placing the unmutilated Report of the Judges at the end of this section of the general Report upon the Live-stock; but the remarks upon the different breeds are kept quite separate.

Longhorns, in the order of the Catalogue, immediately follow the Sussex, and precede the Red Polled Cattle. They numbered only 2 Bulls of 1878 to 1881, and 3 of 1882: 7 Cows, calved previously to or in 1881, and 2 Heifers of 1882; altogether 14 entries; all shown, excepting one cow. The one grand specimen of the breed was Mr. Leigh's "Prior of Ashby," a splendid four-year-old bull, rightly described as brindle and white, but in effect mostly black, with the edges flecked and grizzled; a bull of great scale and character, with quite a picture head, good fore- and hind-quarters, a level top, the line gently rising on the outline over the chine and shoulder-tops into the arch of the neck, and a straight under-line. So ornamental a specimen affords a suggestion of what the glories of the breed must have been in its day. The only really good class of Longhorns was that of Cows, in which the first winner is Mr. W. G. Farmer's "May Flower," own sister to "Gentle," a winner at the Paris International Show of 1878. Her sire, "The Blue Knight," is by "Earl of Upton 1st" (Mr. Chapman's strain), and her dam, "Spring Flower," the first-prize cow at the Liverpool Meeting in 1877, by Sir J. H. Crewe's "Earl of Upton 2nd," a son of her paternal grandsire, so that here is a little in-breeding of the Upton blood. "May Flower," a brindled seven-years-old cow, with well-rounded ribs, is still not so heavy forward as in the hind-quarters. Her neck is light, and the fore-end is not great in proportion to the depth of side; she has wide and thickly-cushioned hips, heavily-packed quarters from hip to tail, lumpy development at the tail-head, and full "twist," or packing above the back of the udder. Mr. Richard Hall's second winner, "Brindled Nell," only four years old, is a thick, good animal from end to end, with great wealth of flesh. Mr. Leigh's "Spondon Queen 2nd" had the reserve; and commenda-

tions, applying to the whole class, are to the credit of Mr. Farmer's "Sweet Briar," a sort of yellow roan or streaky yellow and white, daughter of "May Flower," without father in the Catalogue entry, the Duke of Buckingham's "Governess," and Mr. Satchwell's "May Bud," a cow of the dairy type.

Welsh Cattle, although classed together as one breed, have their distinct sub-varieties. Besides the "Castle-Martin" and other varieties of the black Welsh cattle, there is the smoky-faced red "Montgomery" breed, now nearly extinct,* but represented by two very fair specimens at Shrewsbury. The six Welsh Classes altogether numbered 60 entries: Older Bulls, 6, one absent; Bulls of 1882, all shown, 6 entries; Bulls of 1883, all shown, 7 entries; Cows, 14, one absent; Younger Cows and Heifers, 7, two absent; Heifers of 1882, 13, one absent; and Heifers of last year, 9 entries, all shown. Mr. Oakley's "Sir Watkin," bred by the Earl of Cawdor, took the first prize in the first Class of Bulls, and being exceedingly well up in flesh-points, displays the capabilities of his breed in beef-making. Major Platt's "Black Prince 2nd" filled the second place well, in a class which altogether did great credit to the breeders and exhibitors of the animals by the evidence it afforded of their successful efforts to make the best use of a good sort, which readily answers to the influences of keep and culture. In a strong Class of Bulls of 1882, Lord Harlech's "Zulu," first winner, Mr. Oakley's "Duke of Chester," bred by Captain Best, second, and the Earl of Cawdor's "Young King," reserved number, were all handsome, distinctively Welsh-looking and good in the details of form, flesh, skin and hair. Major Platt's "Rhys," highly commended, a good bull all through, had a different type of head, which, if it could be coloured roan, and seen as Mr. Bates saw the Shorthorn "Belvedere's" head, without a view

* About fifteen years ago, when my attention happened to be turned to the cattle of the English and Welsh Border counties, I received much kind and valuable assistance from the late Mr. Humphry Salwey, of The Cliff, Ludlow, whose intimate knowledge of those counties and his ancient family connection with the Ludlow district, placed him in possession of the best information upon the history, traditions, and resources of the surrounding country. Accompanying Mr. Salwey, I visited the only two herds of pure "Montgomeries" which he could ascertain to be in existence at that time. One has been since dispersed. The best cattle had more style and character than those exhibited this year at Shrewsbury; but the latter have all the distinctive points of the breed, and are, I should suppose, pure-bred. The "Montgomeries" are butchers' favourites, and the butchers have got nearly all of them. The beef is of prime quality, the carcass much heavier than the appearance of the animal would indicate—ordinary stock being the standard. On one occasion the seller, usually an accurate judge of weight, could not agree with the butcher, within two score, as to the weight of a fat "Montgomery" he wished to sell, so he suggested that the scales should be umpire. The butcher agreed, and the real weight proved to be within one pound of two score above the seller's, and four score above the butcher's estimate.—W. H.

of the body, might pass for that of a Shorthorn. Some of the Yearling Bulls are remarkably well grown. The Earl of Cawdor's "Sir Richard," winner of the first prize, has great size for age, and a certain degree of richness to the touch; but these young bulls do not belong to a breed accustomed to feeding up from the hour of birth, generation after generation, and consequently do not, at sixteen months old, bear comparison with breeds so treated. There is a layer of lean flesh over the frame, but not the super-layer, fat prevailing, which makes the young stock of some of the earlier maturing breeds so bounteous under the touch. The same sensations in handling must not be expected; the same terms of description would not be appropriate. The Earl of Cawdor's "Leonora," showing a few silver threads in her black coat, heads a splendid Class of Cows; and in the Class of Younger Cows or Heifers, Major Platt's pair, "Black Queen 4th" and "Bladwen," are great, massive three-year-olds, winning first and second. The first winner is the daughter of a grand, lengthy cow, exhibited by him in the Older Class, and highly commended. Mrs. Williams, of Llandilo, exhibited a handsome cow, and was the breeder of a beautiful heifer shown by the Earl of Cawdor. In the two Younger Classes of Heifers, Lord Harlech's entries carried away all the prizes; but the competition was sharp, and it was only "by the skin of their teeth" that all the five heifers from Glyn got four money-prizes, and one of the reserves. The entries of Mrs. Williams, Major Platt, Capt. Best, Mr. Oakley (successful in previous classes), and Mr. J. Davis, displayed great merit; and those of Mr. E. Pugh, The Newton, Bishops Castle, were the smoky-faced red "Montgomeries" already mentioned.

Dairy Cattle occupied two Classes; Cows, 11 entries, and Heifers 5 entries; one cow and two heifers absent. The first-prize cow, a droop-horned roan Shorthorn, carries a good deal of flesh for a milker, but looks like one that can yield a fairly large quantity of milk, and probably last out better than a poorer cow, while her substance is all in her favour when breeding happens to stop. With the exception of one good Hereford, there was nothing else very specially noticeable; but from a purely dairy point of view, nearly the whole of both classes may be described as satisfactory. One or two well-bred Shorthorns appeared, but generally the cross-bred Shorthorns and mongrels seemed to have more milk about them.

Report of the Judges of Longhorns, Welsh, and Dairy Cattle.

Longhorns are exhibited in very short numbers, except the Cow Class.

In Class 86, No. 746 was a grand animal.

Class 87.—An uneven class, with two very useful animals.

CLASS 88.—A lot of very good cows, which we considered worthy of general commendation.

Welsh stock were well represented, both in numbers and quality; and we desire to express our satisfaction with the progress made in improving this valuable breed.

In CLASS 90 were several animals of great merit.

CLASS 91.—A strong class, the prize-takers showing promise of growing into first-rate animals.

CLASS 92.—A numerous entry, without calling for especial notice.

CLASS 93.—A lot of grand cows.

CLASSES 94, 95, 96.—Heifers of great promise, many of them so good that we had considerable difficulty in making the awards.

Dairy Cows: CLASSES 111, 112.—Some very excellent cows shown, milking properties being in this class the chief consideration.

J. H. BURBERY.
W. B. ROBERTS.
JOHN WILLIAMS.

JERSEYS.

The aggregate of 90 entries in the Jersey Classes was composed of 9 Bulls of the Older Class, 13 of the next Class, 16 of last year, 10 Cows, 6 younger Cows or Heifers, 19 Heifers of 1882, and 17 Heifers of last year. Not many of the animals entered for exhibition failed to appear. One cow had unfortunately died.

The Report of the Judges is succinct; but it is so pregnant of valuable suggestion, and so clear in its indication of the salient points of the Show, that it may be left to itself. Any comment upon the animals, if based upon popular taste in symmetry *and whole colours* (the fancy for these being perhaps quite antagonistic to the pail and the churn as the fancy for symmetrical proportions of form), would seem calculated to weaken the force of the concluding remarks; and notes upon milk-veins, udders, escutcheons, and orange skin of the ear and other parts of animals exhibited, would scarcely answer any useful purpose, or interest the readers of the 'Journal.' The prize-list, therefore, and the Judges' Report, shall speak for the Jerseys; only one circumstance in conclusion may be mentioned. One exhibitor whose name appears in several of the Jersey Classes, the Rev. John Hill, of Shrewsbury, was an exhibitor (of Black Pigs) at the Shrewsbury Meeting of the Society in 1845. It is not often that any exhibitor's name can be found in the Society's Catalogues at both ends of a period of thirty-nine years.

Report of the Judges of Jerseys.

As Judges of the Jersey Classes, it gives us much pleasure to report concerning them that, on the whole, they were good in quality, and satisfactory in number, considering the part of the country where the Show is held.

In Class 104 the individual animals which stood out strikingly the best and richest were Nos. 867 and 863.

Class 105 was a selection of very useful bulls.

In Class 106 we have had much difficulty in selecting the prize animals, many being individually good.

In Class 107 the number was not large, but the three prize animals were also individually very good.

Class 108 was very scantily represented, and we should have liked a stronger competition in this class, having to award three prizes between six animals.

In Class 109 there were 19 entries, and only two prizes offered. No. 918 is so good a heifer, we strongly recommend that a third prize should be given her.

In Class 110 we also recommend that a third prize should also be given to No. 948, being a very promising heifer.

Butter qualities.—It appears to us that often more attention is given to symmetry than to butter-yielding quality. Now this ought not to be. Symmetry is of course valuable to the eye, but there it ends. As the Jersey characteristic is not meat, but butter, symmetry has so much less value, and the marks of high yield in the pail are to be preferred, and should take a higher place than symmetry alone.

It is with great diffidence that we take the opportunity of making these few remarks; but the strong conviction we have formed from our experience of Jersey Cattle, and our anxiety to advocate the best interests of Jersey breeders everywhere, must be our excuse.

P. J. Brideaux.
Charles F. Dorey.
Charles A. Barnes.

SHEEP.

In the Classes of Sheep the breeds happen to be placed in the Catalogue, and grouped for judging, in the same consecutive order; so that departure from the order of the Catalogue, for the purpose of giving at once the whole of any one judicial Report, is not necessary. The order of the Catalogue, therefore, is followed, and when two or more breeds come within one judicial Report, that Report is appended to the notes upon the last of the breeds noticed in it.

The strength of the Shropshire Classes, in both quality and numbers, for many years, prepared every one for a grand display at the head-quarters of the breed. Expectation was not disappointed. The Sheep Classes in general were good; but the Shropshires, represented by a great number of sheep of first-rate excellence, with scarcely a weed among them, composed more than one-half the entire show of sheep. The total number of entries in the Classes of Sheep was 486: the Shropshire entries alone numbered 247; all other breeds together, 239.

As the inspection of shearing precedes the judging, and the disqualifications (only three) come under notice in the course of this Report, the Reports of the Inspectors may be conveniently introduced here.

Reports of the Inspectors of Shearing.

Report No. 1.

After carefully examining the shearing of sheep in this Yard, we find the sheep generally in accordance with the rules of the Society.

We do, however, find in Class 113, No. 971, and in Class 126, No. 1179, and also No. 1180 in same class, not in accordance with the rules as laid down for our guidance in examination, and we recommend the disqualification of the same.

Report No. 2.

We, your Inspectors of Sheep Shearing, beg to state in this our Report of the Shrewsbury Meeting that, as a whole, we did find the sheep well and fairly shorn. In our former Report on the ground we did recommend the disqualification of three sheep, which was acted on by your Council, and we now in our Report confirm the same. We admit that we have met with much more extreme and worse cases in the Showyard; but once allow the matter again to get hold, and we will have the shearing as false as in *former years.* We feel ourselves warranted in giving a good account of the shearing of last season, as in no *year* in which we have visited the Showyard with instructions to correct this evil, have we found greater care and attention given to the shearing of sheep.

The Mountain Sheep did not come under examination. May we be allowed to say that the Judges were placed in a most difficult position on account of so many different classes of sheep being shown for the same Prize. Some of those sheep shorn well, and others of them shown with almost a year's wool on their backs. We congratulate the Council in having corrected so great an evil in a few years. Showing sheep in their *true* and *natural form* in the Showyard is of the very greatest importance.

William Jobson } Inspectors of
J. B. Workman } Shearing.

Leicesters.

Three classes comprised all the Leicesters: Two-shear Rams, 7 entries, one absent, and one disqualified by the Inspectors of Shearing; Shearling Rams, 17 entries, two absent; and Pens of five Shearling Ewes, 5 entries, all shown. Competition was confined to the representatives of six flocks, the entries averaging nearly 5 to each exhibitor. Messrs. Turner, Hutchinson, and Green exhibited in the Ram Classes only; Mrs. Perry Herrick and Messrs. Jordan and Harrison in the Shearling Ram and Ewe Classes. The largest exhibitor was Mr. Turner (Thorplands), who showed 3 two-shear and 4 shearling rams; Mr. T. H. Hutchinson and Mr. J. B. Green had each 2 entries of two-shear and 3 of shearling rams; Mrs. Perry Herrick and Mr. Jordan (Eastburn) each 2 of shearling rams; and Mr. Harrison (Underpark) 3 of shearling rams and 2 of ewes. The Catterick entries, showing the size and character which distinguish Mr. Hutchinson's flock, supplied the first and second

winners in both classes of rams, the noted sheep "Duke of York" heading the two-shears. Mr. Turner, adhering most firmly to that illustration of the true Leicester type which the specimens from Thorplands always afford, exhibited in both classes sheep of beautiful character and unexceptionable symmetry, not on the largest scale, but thick and good throughout; and in the Shearling Class obtained the third prize, which does not appear in the Catalogue, but is offered in the prize-sheet, on the condition that six persons exhibit in the class. This condition applies to all classes of sheep for which no third prize is specially allotted; and in the Class of Shearling Leicester Rams, as we have already seen, all the six exhibitors had entries. Mr. Turner had also the reserve in the Two-shear Class, Mr. Green that in the Shearling Class. Mr. Jordan's two admirable pens of ewes were first and second; but they had worthy rivals in Mrs. Perry Herrick's two pens, and in the one pen exhibited by Mr. Harrison.

Cotswolds.

Two-shear Rams, 6 entries, two absent; Shearling Rams, 9 entries, one absent; and Pens of Ewes, 3 entries, one absent; made up the little show of Cotswolds, good as far as it went. The Two-shear Ram Class contained two noticeably good sheep, the Shearling Class scarcely one which was not noticeably good, and both Pens of Ewes contained animals of sufficiently high merit, and sufficiently well matched, to be accounted good pens. All the first prizes, one second prize, and one commendation, were awarded to sheep of the Signett Hill flock (Mr. Robert Jacobs'), Mr. T. and S. G. Gillett's grand two-shear ram and pen of ewes taking second prize, and one of Mr. Godwin's entries having a reserve and commendation. The ages of Cotswolds usually date a month or two earlier than those of other Long-wool breeds.

Lincolns.

The three Classes contained 20 entries—5 of Two-shear Rams, 11 of Shearling Rams, and 4 of Ewes. One two-shear and two shearling rams were absent. Messrs. Smith, Dudding, Pears and Roe were the only exhibitors. Two of the three first prizes, those for rams, went to the entries of Mr. Smith, that for ewes to the pen of Mr. Pears; the second prizes to the sheep of Messrs. Dudding, Pears, and Roe; the reserves to those of Messrs. Smith, Dudding, and Pears; and a commendation to Mr. Roe's ewes; so that each had a share of the honours. Although the smallest in number of entries, the Class of Ewes

was the best, the four pens containing twenty very good animals. The first prize two-shear ram, Mr. Smith's "Lord Gainsborough," although the line of his back is at a high level compared with the sheep standing near him, comes near the ground, has great breadth of back and width through heart and centre, carries abundant flesh, and wears a good coat. His shearling also deserves his place on the prize list, although Mr. Pears' second might attract first notice at a superficial glance; but when examined more closely, he has rather too much daylight under him, and wants time to grow down to his legs, and has not the same width of "floor," or under-part of the body, as the sheep from Cropwell Butler.

Report of the Judges of Leicesters, Cotswolds, and Lincolns.

Leicesters: Class 113.—An average class; short entry.

Class 114.—On the whole a good class, both as to numbers and quality.

Class 115.—A very good class, the whole worthy of commendation.

Cotswolds: Class 116.—Short entry, but quality good.

Class 117.—A very good class; the first-prize sheep of good form and quality.

Class 118.—Only two entries, but we think the second worthy of the prize.

Lincolns: Class 119.—Small exhibition; first-prize animal good sheep.

Class 120.—Fair entry, class good.

Class 121.—A very good class.

Robert Fisher.
Robert Garne.
William Hesseltine.

Oxfordshire Downs.

The Two-shear Ram Class contained 5 entries, all shown; the Shearling Rams made a strong class of 27 entries, only two absent; and of 9 entries of Ewes, one had been cancelled, and all the rest appeared in their places. Not great in number, the Elder Rams were excellent in quality, and Mr. Albert Brassey's York first-prize shearling, "The Nobleman," now a grandly developed two-shear sheep, was fairly passed by Mr. Treadwell's "Bicester" and "Young Comet," the former a large ram of splendid form and quality, well set on his legs, with a thickly fleshed back, ample legs of mutton, and a heavy twist filling the space between them; "Young Comet" is a sheep of great size and massiveness, excellent under the hand. In the Shearling Class, Mr. Brassey's "Toby 2nd," from a ewe by "Royal Kilburn," the grandsire also of "The Nobleman," was first; "Peterborough 2nd," by "The Nobleman's" sire, "Peterborough," had a high commendation; and "Shifford," a son of "Royal Derby," was commended. The Heythrop Park shearlings, in fact, numbering six, were a remarkably grand lot.

Mr. Treadwell had seven entries in the class, six exhibited, and took the second prize with "Baron Campsfield," a son of "Baron Newton," his Derby second-prize shearling; the reserve and a high commendation with "Baron Hampton," a son of Mr. Hobbs' "No. 6;" and a commendation with "Young Traveller," by "Baron Oxford." There was another ram by the sire of the reserve ram, unnoticed in the list of awards, but from his grand proportions and wonderful wealth, breadth of beam and deeply covered loin, is very suggestive of the high merit of "No. 6" as a sire. The third prize was well won by one of three capital shearlings exhibited by Mr. Milton Druce. The Fyfield ewes, also, prominently placed, won the second prize in a very creditable class. Mr. Brassey's two pens, good and well brought out, were first and reserve; between them (showing the closeness of the competition) Mr. Milton Druce's taking the second, and Mr. Hunt's the third prize.

Report of the Judges of Oxfordshire Down Sheep.

The old sheep consisted of five entries, amongst which we found some very good massive sheep.

In Class 123 we had 27 sheep; the general quality was good, and we consider we were fully justified in awarding the three prizes.

In Class 124 we had 8 pens, and we consider the three first pens were over an average merit for the Royal, and we therefore awarded the third prize in this class.

Charles Hobbs.
William Jonas.

Shropshires.

Perhaps it is well here to refer to the facts that towards the sum of 345*l.* offered in prizes for Shropshire Sheep, the Shropshire Sheep Breeders' Association and Flock-Book Society contributed 105*l.*; the Shropshire and West Midland Agricultural Society 60*l.*; that fifty guineas in the Class of Single Shearling Rams, and fifty guineas in the Class of Pens of five Shearling Ewes, were offered by Messrs. E. Webb and Sons, of Wordsley, Stourbridge; and that Messrs. Beach and Company, of Dudley, added a piece of plate of the value of ten guineas to the first prize in the Class of Pens of ten Ram Lambs, and a piece of plate of equal value to the first prize in the Class for Pens of ten Ewe Lambs. These contributions show how the importance of the Shropshire sheep is recognised, and that the Society's efforts to secure an adequate representation of this now almost universal breed in the county from which it takes its name, and in which so many of the long-established flocks are kept up to the highest possible excellence, received substantial assistance.

The first Class, that of Two-shear Rams, contained 34 entries, or, discounting absentees, 30 sheep in the pens. Descriptions of the winners will be found in the annexed Report of the Judges. Capt. Townshend, the breeder of the first-prize ram, was also the exhibitor of a highly commended ram, his "Lord Coventry," bred at Caldicote Hall, excellent in form and quality, with the fine wool-growth spreading so much over the face as only to leave spaces enough to show the black ground-colour and let the eyes look through. Many of the unnoticed sheep would have been good enough to win if the best had been away, and unsuccessful exhibitors (including some of the leading breeders) must have felt that defeat in such a class was very far from disgrace.

But the great Class of Single Rams was that of Shearlings, not only for the extraordinary number of 101 entries, of which eight were absent and two disqualified by the Inspectors of Shearing, leaving 93 sheep in the pens and 91 in competition, but also for the surpassing merit of a large proportion of the class. If great credit was due, as it certainly was, to the breeders who sent up such a display, great credit was also due to the Judges, who most ably discharged the enormously heavy duties of their task. By competent men, whose partialities, if anything excepting their judgment influenced them, might be supposed to incline towards other than the winning sheep, the awards were emphatically approved.

The near approach to ideal perfection (which is—no points at all—or, each point in such true proportion to each other point as not to be appreciably better than any other) increases the difficulty of description. There is nothing to catch hold of in these models, so if we want subjects for telling description we must go to the worse end of the class. If the Judges felt this as keenly as the official reporter, they got out of the scrape very cleverly—*vide* their report on Class 126. Lord Chesham's four, three by "Dudmaston," and one by one of his sons, two out of "Comus" ewes, one from a dam by "Prince Imperial," and one from a "Royal Aston" ewe, were equally beyond praise and description, excepting such praise as nauseates and such description as fails for want of faults to bring out the merits into relief. It is a "Dudmaston-Comus" ram that had the first prize of 67*l.* 10*s.*; and another, bred from the same sire and dam's sire, took the fifth prize, the third and fourth Latimer entries being both highly commended. Mr. Joseph Beach, of The Hattons, was the exhibitor of the second winner, Mr. T. J. Mansell (Dudmaston) having the third-prize sheep, and Mr. R. M. Knowles the fourth-prize sheep. Capt. Townshend's flock again came into notice in the representative form of

"Trueman," a capital shearling by "Sir George;" but his "Prince Teck" escaped notice in the multitude of high-class sheep competing. As the list of commendations is not added to the prize-list in the Appendix, and in these two classes of rams, commendation, whether high, low, or of medium level, means selection of exceedingly good sheep from among good sheep, the names of those breeders whose sheep in either or both of the classes received that honour may be here mentioned:—Mr. Thomas Mansell (Harrington Hall); Mr. M. Williams, Jun.; Mrs. Maria Barrs; Mr. J. Bowen-Jones; Mr. T. S. Minton; Mr. T. J. Mansell (Dudmaston Lodge); Mr. T. H. Miller; Mr. R. Loder, M.P.; Messrs. Crane and Tanner (Shrawardine); Mr. R. Thomas; Mr. Thomas Fenn; Mr. J. E. Farmer; Mr. F. Bach, and the Executors of the late Mr. W. German; and there are two or three other exhibitors, whose names are also in the prize-list, or have been mentioned already in connection with the sheep highly or otherwise commended. To these might be added a long list of exhibitors of meritorious sheep unnoticed. Three very useful shearlings, *uncoloured*, were exhibited by Mr. Charles Randell, of Chadbury.

Class 127, Pens of five Shearling Rams, contained 33 entries; 30 pens, or 150 sheep, were exhibited. Of course, the merit of the sheep singly was not quite equal to that of the rams in the immediately preceding class, because (as a rule) any exhibitor who had a supremely good one naturally chose to let it stand upon its merits in single competition rather than spoil the appearance of four good sheep in a pen; but really the class was almost more wonderful and more creditable to the breeders and the breed, if possible, than the class of single entries. The matching in so many of the pens was something extraordinary, showing that the uniformity which every good breeder desires has been in a great measure obtained. Lord Chesham's first-prize pen, admirably matched in character, all large, of true symmetry and immense substance, with good heads, was an instance of exception to the rule that the best sheep go into single competition. Any one of the five was quite good enough for the strongest competition in a class of single entries, and it is questionable whether the best in the pen was not a better sheep than any exhibited singly.

The Class of Pens of ten Ram Lambs, 13 entries, one cancelled, had each one of the 12 pens filled. The full number of lambs, therefore, was 120; and in the next following Class of Pens of ten Ewe Lambs, 14 entries, one cancelled, three other pens empty, 100 lambs were shown. These 220 Shropshire lambs formed an interesting feature of the Show, as examples of the growth and development of the Shropshire at the age of about

four months, most of the lambs having been dropped in March, a few in February, and a few in April. Messrs. Bradburn, the exhibitors of the first-prize two-shear ram, had the first prize for ram lambs, and the second for ewe lambs; Mr. R. Thomas, of Baschurch, the first for ewe lambs, and third for ram lambs; Mr. W. H. Beech, of Codsall, the second for ram lambs; and Mr. Loder, the reserve in the male and third in the female class. Some commendations were also awarded.

The pen of ewes exhibited by Mr. Joseph Beach, of The Hattons, was the foremost feature of a splendid Class of Pens of five Shearling Ewes, containing 41 entries, but six being absent, 175 animals were shown. Here again the Latimer flock was well represented, and Messrs. Williams and Bradburn were also successful, the Earl of Shrewsbury's pen having the reserve, a good position in so strong a class, and the Oaklands, Whittlebury, and Shrawardine pens, and those of Mr. E. Farmer and Mr. W. German's Executors receiving commendatory notice. Messrs. Bradburn's ewes were at the head of the last Class of Shropshires, Pens of ten Breeding Ewes, 11 entries, one absent, 100 ewes in the pens. The Report of the Judges, and the prize-list, will tell the rest. Although the labour of judging was divided, Messrs. Coxon and Evans taking the rams, and Messrs. Bowen-Jones and Keeling the ewes, the following joint Report has been returned by the four Judges.

Report of the Judges of Shropshire Sheep.

The exhibition made by the Shropshires cannot be deemed otherwise than worthy of this now most popular and much admired breed of sheep. Taking place as it did in their own district, much was expected of them, and the Judges congratulate the breeders on the fact that the Shropshires formed perhaps the most striking feature of this most successful Show; and in exhibiting, as they did, more than double the number of sheep as compared with all other breeds put together.

Class 125, for *Two-Shear Rams*, contained 34 entries from most of the principal breeders of this class of sheep. The first-prize animal was a good specimen, carrying beautiful character, with good head, straight spine, well covered with a fine fleece. The second-prize had splendid touch, with a well-covered back. The third-prize, No. 1096, showed great masculine character with heavy flesh.

Class 126 contained the unprecedented number of 101 entries, giving the Judges a most trying ordeal to award the five prizes allotted to the class. Amongst the yearlings were a large number of first-class animals, reflecting great credit upon the breeders. The competition was very close, and the numerous commendations testify that many of the rams which were commended were nearly on a par with those to which prizes were awarded.

Class 127, for *Five Shearling Rams* from one flock, calls for special notice, containing as it did no fewer than 150 animals of extraordinary merit, showing that the Shropshire breeders have no fear of exhibiting their sheep in numbers.

Class 128, for *Ten Ram Lambs,* contained 120 animals, many of which possessed good character, and were likely to develop into good sheep.

Class 129 contained 130 ewe lambs, to which the same remarks will apply as to the ram lambs.

Class 130, for *Shearling Ewes,* was represented by 41 pens of 5 each, forming in themselves a grand exhibition. The first prize was awarded to No. 1294, being as perfect specimens as any breeder could possibly desire.

Class 131, for *Ten Breeding Ewes,* had 10 entries, but calls for no special remark.

John Evans.
John Coxon.
Charles R. Keeling.
J. Bowen-Jones.

Southdowns.

The Southdowns filled three tolerably strong classes; Two-Shear Rams, 19 entries, six absent; Shearling Rams, 32 entries, four absent; and Pens of five Shearling Ewes, 9 entries, one pen absent. In quality, the general estimate was that they stood in order of merit as good, better, and best; the Two-shears forming an unquestionably good class, with one or two notably fine rams in it, but not on the whole equal to the larger Class of Shearlings, which for their number had a very small proportion of inferior sheep among them; while the show of Ewes was particularly good throughout, not a bad or middling pen to be found in it. In all the classes the Sandringham flock was well represented, better in the better Class of Shearlings than in the good Class of Two-shear Rams, but best in the superlatively excellent Class of Ewes, in which the only pen from Sandringham had the second prize. Mr. Chapman's two-shear ram, well known as a winner elsewhere, took the lead in his class; and Mr. Carew-Gibson's, in the third place, separated Lord Walsingham's second and reserve sheep; and in the Shearling Class the Merton sheep came out in greater strength, with four entries, but one was absent, and the three exhibited took the first and third prizes and the reserve number. Indeed, it is noticeable that not a single entry from the Merton flock was passed over by the Judges. In the Two-shear Class, as in the Shearling, four entries had been sent, but one of the four did not appear in the pen; and in that class, besides the honours already mentioned, a commendation was awarded, while the one pen of Merton ewes received the third prize. Mr. Colman, whose shearling ram was second in his class, was still more fortunate in winning the first prize for ewes. Sir W. Throckmorton had two or three good sheep in the Shearling Class, one particularly good; and a pen of beautiful ewes highly commended; as also were the ewes of the Duke of Richmond, Lord Hastings, and Mr. Jonas, of Ickleton, the latter having the reserved number.

Hampshire Downs.

The only fairly strong class in point of number was weakened by the absence of nearly half of the number entered. The Two-Shear Rams, 5 entries, were all in their places; but the Shearlings, 11 entries, mustered only six in the pens: of five entries of Pens of Ewes, one had been cancelled, and the remaining four appeared before the Judges. Here, again, the females were first in merit; but what artistic colouring! For two of the pens the blush-rose, and for one pen the yellow marigold, might have been the pattern tint. It is very pretty, certainly, but what does it mean? Upon the same principle of improvement upon nature, why should not the black coats of the Welsh cattle be powdered blue, or the Shorthorns appear in pea-green? The horses generally are too sleek for similar appliances, but they might receive a coat of varnish. Mr. H. Lambert's pen of five splendid yellow ewes was fairly first in the prize list, the beautiful pink ewes of Mr. H. Spackman and Mr. F. R. Moore taking respectively, and deservedly, the second and third places. Mr. F. P. Brown, whose ewes were not quite in the same bloom, although intrinsically good, filled the remaining pen. Mr. F. R. Moore's rams in both classes were sheep of grand substance and quality; his two-shear rams were uncommonly heavy-fleshed, great in the neck, over the loins, in the legs of mutton and connecting twist, with a thick layer under the breast and floor of the chest. Mr. Read's sheep made good second winners in both Classes of Rams.

Report of the Judges of Southdown and Hampshire Sheep.

The *Southdown* classes were well filled, most of the principal flocks being represented.

Class 132.—*Two-shear Rams* were very good, and Class 133, of *Shearlings*, numbering 32 entries, were especially good; and Class 134—*Shearling Ewes*—were remarkably fine without exception.

The *Hampshire Downs* were not very fully represented, but some fine specimens of the breed were shown, especially in Class 137. The whole of the pens of ewes in this class were of considerable merit, and the prize-winners were exceptionally good.

Richard Relfe Verrall.
Joseph Carpenter.

Mountain Breeds.

It is probably quite impossible for the Royal Agricultural Society to listen to the applications for separate classes which come from so many quarters. Here we have a miscellaneous collection of Exmoor, Scotch, Welsh, Clun Forest, and Lonk Sheep; yet if we look at the numbers of each, how could separate

classes be reasonably expected? and if separate classes were granted, some aggrieved Herdwick breeder, or some breeder of the White-faced horned Limestone sheep, might complain that there was no room for him, and demand additional classes. The Two-shear Mountain Ram Class at Shrewsbury contained 13 entries (all pens occupied), of which 6 were Exmoor Horned, 2 Scotch, and 5 Welsh sheep; the Shearling Class, 17 entries (all shown), comprising 4 Exmoor, 3 Scotch, 7 Welsh, 1 Lonk, and 2 Clun Forest; and the Class of Ewes (5 shearlings in each pen), 10 entries, one absent, the 9 divisible into 4 Exmoor, 2 Scotch, 1 Welsh, and 2 Clun Forest pens. In the Class of Older Rams, all the prizes and the reserve went to the Exmoor sheep; in the Shearling Class, the first and second prizes to the Clun Forest sheep, the third to a Scotch ram, the reserve and a high commendation to the Exmoors, and a commendation to one of the Welsh entries (one of the 7 Welsh entries, by-the-bye, had much of the Exmoor type); and in the Class of Ewes, again, the first and second prizes were awarded to pens of the Clun Forest breed, the third prize and a simple commendation to Exmoors, and two high commendations to Scotch sheep. The only specimen of the Lonk (a pen of ewes of the same flock, entered, being absent) was passed unnoticed.

Other Breeds.

"Other Distinct Short-woolled Breeds" were all comprised in two small classes: Rams, One-shear or Two-shear, having 7 entries, six exhibited; and Shearling Ewes, three pens of five, all shown. The six rams belonged to three exhibitors, two entries to each—Mr. F. Shepherd showing Ryelands; Mr. Smith, Suffolk sheep; and Mr. Herbert Farthing, the Somerset and Dorset horned breed. The same three breeds also were represented in the Class of Ewes, the Ryelands and Suffolks being exhibited by the same breeders; the Somerset and Dorset Horned by Mr. H. J. Smith, of Stoke Abbott. Mr. J. Smith, of Thorpe Hall, last year very successful with his Suffolk sheep at York, won the first prize for his shearling ram, "Ben," and the first prize for his pen of ewes; the second prize in the Ram Class going to a Ryeland, and in the Ewe Class to the Dorsets.

Report of the Judges of Mountain and other Distinct Breeds of Short-woolled Sheep.

The classes of *Mountain Sheep* are certainly a most peculiar lot to adjudicate upon, there being so many breeds in the same class—some shorn, and others not—which makes it still more difficult, and we think that a subdivision of these classes may be worthy of the consideration of the Council.

Most of the exhibits we considered were very good specimens of their breeds.

The other *Short-woolled* classes were well represented in quality, though not in numbers, there being three entries in each class, each one being of a different breed. The *Suffolks* were superior in both classes, followed with good exhibits of *Ryelands* and *Dorset-Horned*; latter class exceptionally good.

T. Williams.
Rob. Shortreed.

PIGS.

The Judges of the Black and other distinct Breeds (excepting the recognised White Breeds, which have precedence in the Catalogue) have made so exhaustive a Report upon the classes brought under their notice, that little remains to be said; and to this elaborate Report one of the Judges, a highly competent authority, has added a note which is in itself an epitomised history of the Small Black Breed. The Judges of the White Breeds, more briefly, have given an outline of their department of the Show. These Reports will be found in their order, each at the close of the group of classes to which it refers.

Eight disqualifications by the Veterinary Inspectors on account of the advanced dentition of the pigs entered for competition are recorded, and in one other case disqualification was pronounced on the ground of the state of dentition of young pigs, accompanying their mother, showing age beyond eight weeks. The following are the Inspector's Reports:—

Report of the Inspectors of Dentition of Pigs.

We, as Veterinary Inspectors to the Royal Agricultural Society, have examined the pigs entered in Classes 144, 146, 148, 149, 150, 152, 153, 154, 156, 157, 160, 161, 164, and 165, and find that in the pigs No. 1507 in Class 149, No. 1537 in Class 152, No. 1551 in Class 153, No. 1569 in Class 156, No. 1605 in Class 160, Nos. 1612, 1618, and 1625 in Class 161, the state of the dentition does not agree with the age given in the book of entries.

In Class 145, the young pigs with No. 1478 show a state of dentition beyond the stipulated age of 8 weeks.

W. Duguid.

Besides these disqualifications, one sow (No. 1576) was declared disqualified (under Rule 22) in consequence of a protest handed to the Steward of Swine, calling attention to the fact that the animal had been coloured and oiled, contrary to the rules of the Society.

Large White Breed.

Boars farrowed in 1881 and 1882 numbered 6 entries; last year's Boars, 7 entries; Sows, 14 entries; and Pens of three

Breeding Sows of the same litter, 5 entries. The first prize in the first class was awarded to Mr. Joseph Ashworth's "Yorkshireman;" the pig that had the reserved number in the same class at York; and a son of the same boar, belonging to the same exhibitor, was first in the second class this year. Major Platt's, Mr. P. Ashcroft's, and Messrs. Nuttall's breeding sows, as winners, scarcely give their class a very high character, although fairly useful-looking. Messrs. J. and F. Howard's Pen of Young Sows, first in the next Class, were pretty well up to the usual quality of the Britannia Farms herd, although their older sow was considered a shade below the Large Breed Standard—a fault not often found in pigs from that source.

Middle White Breed.

Older Boars, 5 entries; Younger, 6; Breeding Sows, 13; and Pens of Three, 5 entries; made the show of Middle Breed White Pigs. Beyond Mr. P. Ascroft's older boar and Mr. Walker Jones's "Dynamite," in the same class, there was little to notice in the male classes, excepting the name of Major Platt's boar "Jenny," in connection with that of his sow, "Sol," in a previous class (these entries were from Wales), and a big boar which got into a Middle Class by some error of description. The Younger Boar Class was wretchedly poor; two-thirds of the pens were empty, and the other third not very creditably occupied. The Breeding Sows were a very fair lot, some good, so far as the Showyard model pig is concerned; and as that model is recognised, and all Judges are expected to keep the approved form in the mind's eye during the process of judging, no objection to the awards at Shrewsbury can be entertained.

Small White Breed.

A Class of Older Boars of considerable merit numbered 8 entries; Younger Boars, 14 entries; Breeding Sows, a good class, 17 entries; and Pens of Three, in which a prize was awarded to the pen from the Prince Consort's Shaw Farm, 8 entries. The well-known Tortworth strain was represented by both the first-prize boars and the reserve boar in the Younger Class, and the Coleshill strain by the first-prize breeding sow and the first-prize Pen of three Sow Pigs.

Report of the Judges of Pigs of the White Breed.

In Class 143 we found three pigs absent, and the first-prize pig was the only one fit for competition.

Class 144.—A very moderate class, and short of entries.

In Class 145, No. 1469 was considered by us more fit for the Middle Breed

class than the larger. No. 1478 was disqualified, owing to the pigs exhibiting with her being over age.

In CLASS 147 we found No. 1490 more fit to be exhibited in the Large Class than in the Middle.

In CLASS 148 four pens were empty, and neither of the pigs were good; and the Judges were long before they concluded to award a second prize.

In CLASS 149 four pens were empty, and we can commend the whole class with the exception of one pig.

CLASS 151 was an average class.

In CLASS 152 three pens were vacant.

In CLASS 153 four pens were vacant, and we can generally commend the whole class with the exception of two pigs, viz. Nos. 1552 and 1553, which we admire, but consider these two pigs are entered in the wrong class.

WILLIAM R. W. BESWICK-ROYDS.
JOSEPH SMITH.
JOSH. CULSHAW.

SMALL BLACK BREED.

The excellent Report of the Judges, as already intimated, deals so fully with these classes, that the following statement of numbers may be considered sufficient introduction:—Boars of 1881–2, 5 entries; Boars of 1883, 4 entries; Breeding Sows, 4 entries; and Pens of three Breeding Sow Pigs, 3.

BERKSHIRE.

Boars of 1881–2, 8 entries; Boars of 1883, 19 entries; Breeding Sows, 31 entries; Pens of three Young Sows, 11 entries.

OTHER DISTINCT BREEDS.

Boar of 1881–2, 2 entries; Boars of 1883, 5 entries; Breeding Sows, 6 entries; and Pens of Three, 3 entries. A remark of the Judges suggests the expression of a hope that before the Tamworth pig is excluded from the Shows of the Royal Agricultural Society of England, he may have a fair test in rearing and feeding, and then in ham and bacon curing, and in household use, side by side with some of the model pigs of the recognised Showyard type.

Report of the Judges of Small Black Pigs, Berkshire and any other Distinct Breeds.

The *Small Blacks* were representatives of the homesteads of the Duke of Hamilton, Mr. J. A. Smith, Major Dods, and Mr. Northey. The latter had one entry, and although the animal—a sow farrowed in 1882—was bred in Devonshire, the pedigree as given in the Catalogue reads as of Suffolk origin. The same may be said of Major Dod's (No. 1365), who dates from Great Yarmouth. The other two exhibitors are from Suffolk, and the pigs shown by them are the lineal descendants of the original "Black Diamond"

strain, so famed as prize-winners in years gone by, under the colours of the late Mr. Thomas Crisp, Mr. Mumford Sexton, and Mr. Stearn.*

Of the prizes awarded, the Duke of Hamilton takes all four firsts offered, Mr. J. A. Smith three seconds, and Mr. Northey one. In the Report we are requested to make on the pigs brought before us, there is little to dwell on as regards individual entries. The best in the Boar Classes we took to be the young one from Easton Park, No. 1572, but his hair was scant and short, and we think the Duke has shown better animals elsewhere. The *Old Boars* were an unsatisfactory class to judge; so unlike each other, so varied in character, so different in their merits and defects, that we had great difficulty in arriving at a conclusion as to their proper places on the prize-list. We decided, however, that the depth of carcass, heavy hams, and good hair of the Duke of Hamilton's "Young Robert" gave him an advantage over Mr. Smith's thin-faced, short-ribbed, but grand-backed "Akenham Hero," No. 1564, to which we awarded the second prize. The reserved number fell to the Duke's "Young Sam," a pig with a model fore-end but a wretched back, and otherwise not a Show boar.

The *Sows* were better; the winner a very good one indeed, from the same sire as the Duke's first-prize boar, but withal of a higher-class stamp. Mr. Northey's second-prize sow is a heavy-fleshed, short-legged animal, with a good face, but of a soft, fatty handling, which betokens a very little lean meat, and was sent before the Judges, contrary to law as we were informed, with a decided appearance of artificial colouring.

The three young sows of the Duke of Hamilton's pen No. 1579, were well-grown specimens of the breed, every advantage having been taken of the early farrow, the Catalogue states. They were sired by the reserve-number boar, but showed a decided improvement on his form and build.

On the whole, we thought there was a want of uniformity of character,

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* The present race of "Small Blacks" have their home very much in East Anglia. They are more or less, as stated above, the descendants of the pigs with which the late Mr. Thomas Crisp, of Butley Abbey, Mr. Sexton, of Wherstead, near Ipswich, and Mr. Stearn, of Brandeston, all in Suffolk, won with all over the kingdom twenty-four or thirty years back. These were improvements on what Sir Thomas Western and the late Mr. Fisher Hobbs worked up out of the original Essex breed crossed with the Neapolitan pig. One of the most successful introductions of a fresh strain was from Devonshire, in all probability from one of the same family whose name appears in the same Report. A boar, known in the county of Suffolk as "Northey," had a lasting influence on the breed. He was used by Mr. Wolton, of Kesgrave (a celebrated breeder of Suffolk horses, since removed to Butley Abbey), with the greatest success, and, I believe, Mr. Crisp had him for some time after Mr. Wolton had done with him. In 1855, Mr. Crisp sent one of his best sows (a descendant, I believe, of the "Northey" boar) to the Paris Exhibition. The Judges condemned her as *too fat to breed*, and withheld the prize. On her voyage back she gave birth *to eleven good pigs*, and brought them all up. The litter made what at that time were called fabulous prices. One realised 50 guineas, and the best blood in East Anglia goes back to this famous litter of pigs. The sow was called "Black Diamond," a name by which the Small Black Breed of East Anglia is well known at the present time. Mr. Crisp died about 1869, and the pigs were sold off. Mr. Stearn, who was one of the most successful breeders of the "Black Diamonds," has ceased to show; and Mr. G. M. Sexton sold off his pigs by auction three or four years ago. He did more to spread the fame of the Blacks than even Mr. Stearn or Mr. Crisp. Mr. J. A. Smith, one of the most successful breeders of the present day, bought largely of the Wherstead strain, and though the agent of the Duke of Hamilton has brought the Easton Park pigs to the front a good many times in the last few years, one and all derived their original stock from the "Black Diamond-Northey" strain alluded to above.—H. B.

a varied type of hair and form, which looks as if the breeders of the Small Blacks of the present day had no particular model before their eyes in their efforts to produce a prize pig. Certainly those brought before us at Shrewsbury lacked that precision of character which Messrs. Sexton and Stearn gave us twenty years ago.

The *Berkshires* showed nothing of this; with certain exceptions there was a commendable adherence to the recognised characteristics of the breed in the entries we looked over. Indeed, the hard-fleshed, "lean-meat" appearance of which the Berkshires had outward evidence gave one the idea of satisfying the present-day requirements much more than the soft-handling specimens in certain other classes of both colours. In making our awards, we endeavoured to keep what we considered the true type well before us, and, so far, we had ample choice among the good ones. We thought *Boars*, old and young, and *Sows* of the old class, a very grand display. We passed over one of the most perfectly formed animals among the Berkshires without bestowing even a commendation. This was Sir W. Throckmorton's No. 1613. We did so on account of her marked divergence from Berkshire character. She had neither the form, the hair, nor the facings of the breed. If there is any strange blood in her pedigree, we were right in our decision; and if from a pure stock, this eminent breeder has worked his material into a manufactured article of another type, and we made our protest against the innovation.

There were far too many individually good specimens to make it necessary to call especial attention to any particular entry, beyond the scale of merit we recorded in our awards; and if the Class of *three Young Sows* appeared to come short of the standard of excellence which the older exhibits possessed, the reason is obvious. It is quite enough for the breeder to produce a single animal which shall peer above his fellows in a class of twenty or thirty; to produce *three* good animals in one litter is more than can often be accomplished. We may, however, say that in this class the feeding talents of many of the exhibitors were evidently beyond that faculty best described as the "breeder's eye." In a pen of young sows for breeding purposes there should be something besides the up-hill and down-dale outline of a forced maturity without form or promise.

Of the Classes for *Other Distinct Breeds* we have little to say. The Tamworth pigs had it all their own way; the informal entries of others which appeared on the list were simply out of court because there were places for them elsewhere, and were passed over accordingly. Possibly the unsightly, sandy-skinned, long-legged specimens to which we awarded the prizes possess merits beyond their personal appearance; otherwise we are not sure we ought to have encouraged the exhibition of anything so wide of the recognised form of animal life in the Showyard.

We have one more note to make. We remarked there were no prizes for sows with pigs on them. It appears that fecundity in swine is a quality the Council of the Royal Agricultural Society of England does not recognise as worth encouragement. Now to those who have had any experience in pigs it is well known that nothing baffles the skill of the breeder more than the tendency that cultivated specimens invariably exhibit of a non-breeding disposition. You get form, early maturity, fattening qualities—everything that ambition attempts, but this is always more or less attended with the disappointment of smaller and smaller litters as the cultivating process goes on. This will perhaps be charily admitted by the breeder of fashionable sorts; but we ask those who are practical pig-breeders if it is not almost invariably the case? Would it not be well to give prizes for sows shown with not less than six, eight, or nine pigs? Let the pigs have nothing to do with the chance of the mother's winning; to judge the dam in connection with the produce always creates a difficulty; only let it be shown that the model sow

has the indispensable property of being able to perpetuate her species, and that in quantities compatible with profitable pig-farming.

HERMAN BIDDELL.
G. E. LASCELLES.

CHEESE AND BUTTER.

As Dairy-produce is closely connected with the subject of Live-stock, this seems to be the fittest place for the following Report:—

Report of the Judges of Cheese and Butter.

There was a large show of *Butter*, and, with few exceptions, the quality was extremely good, possessing the rare old English delicate flavour. One or two lots we disqualified, evidently having been mixed with salt. We noticed an absence of colour in most of the samples, which is somewhat unusual at this period of the year.

Although the entries of *Cheese* were not numerous, the quality was exceptionally good, and the condition excellent for the month of July.

We noticed an entire absence of *Foreign Cheese*, and regret that there were no entries of Stilton, which certainly ought (in our opinion) to be included in the Catalogue of the Royal Agricultural Society of England.

We had some little difficulty in awarding the prizes, in consequence of the general excellence of the exhibits, and hence we have highly commended and commended several lots.

On the whole, we consider the Show a very good one in our department.

JOHN EASTTY.
JOHN STAFFORD.

BEES.

Happily little acquainted with the "points" of these irascible insects, the writer must beg to decline criticism upon this department of the Live-stock at Shrewsbury; but would express a confident anticipation of good results from the exhibitions of Bee-management at the Society's Meetings. The cottage bee-keepers of England commonly go so ignorantly on in the clumsy and often cruel methods of their ancestors, that it would be well if, through the Society's instrumentality, instruction in modern systems could be still further extended to them.

The reader of this Report may have noticed that the writer, although not always in perfect accord with the Judges in their awards and comments, has endeavoured to abstain from strongly marked variance, and to recognise, in all cases, the authoritative character of the judicial decisions. This he is anxious to emphasise, because, in a rather large acquaintance with breeders who are also exhibitors, he repeatedly hears remarks which indicate the existence—not, happily, the prevalence—of a very

cramped, warped, and twisted notion of the spirit in which such men as officiate at the Shows of the Royal Agricultural Society of England discharge their duties, and a very imperfect notion of the responsibility which an exhibitor incurs. Incompetency, often, dishonest partiality, sometimes, is imputed to the Judges. May not the theory of exhibition be thus stated?—The question at issue among breeders, or between each exhibiting breeder and each other exhibiting breeder, is as to the comparative merits of certain animals in the possession of those breeders severally. That question is submitted to arbitration, and is to be decided in the Showyard of the Royal Agricultural Society by men appointed by a competent elective body representing the exhibitors. The Judges are selected as men of high character, and as each an expert in his own line; and the exhibitors, by the act of entering their animals for show, and again by the act of sending them to the Showyard, accept the arbitration of those Judges, and should frankly and loyally abide by it. To discredit the Judges because they have decided against a certain animal, would seem to be a most ungenerous act, if it were not worse than that, a breach of good faith; just as much so as a dishonest decision on the part of the Judge would be. The exhibitor sends his animal in faith that a competent Judge will act honestly; the competent Judge accepts office (theoretically, at least) in faith that the exhibitor will accept his decision as an honest one. The difficulties of Judges can be rightly estimated only by those who have themselves officiated as Judges, and who have so learned how many questions, beyond mere outside appearances and sensations perceived by touch, must be mentally asked and answered before a faithful decision can be given. We want a little more English manliness, a little more gentlemanly superiority to mean suspicion; not among exhibitors in general, but among those of an unhappy minority to whom the foregoing remarks may apply.

XXII.—*On the Purification of Water by means of Iron.* By W. Anderson, C.E., M.Inst.M.E., Consulting Engineer to the Royal Agricultural Society of England.

It has long been known that iron possessed the remarkable property of removing colour from water, and of decomposing organic matter held in solution.

Some twenty-seven years ago, Dr. Medlock took out a patent for the use of iron as a purifying agent; but it was not till within the last fourteen years, when Professor G. Bischof took

up the subject, that anything really practical was done. Since that period, however, a great development of the use of iron has taken place, and it has now reached a position of such hygienic importance, that a notice in the pages of this 'Journal' cannot fail to be both interesting and useful.

In an excellent article on the composition and properties of drinking-water, and of water used for general purposes,* Dr. Voelcker has fully explained the conditions which render water fit for the arts and for dietetic purposes; and he alludes in that article to those important properties of spongy iron which Professor Bischof has laboured with unwearied constancy to adapt to the purification of water.

First, Professor Bischof had to provide the metal in a suitable form, in sufficient abundance, and at a low price for use in filters. This he accomplished by improving the process of reducing the "purple ore" of commerce, the refuse of the roasting of iron pyrites, by means of coal and coke, regulating the temperature of the furnace so as to allow the particles of reduced iron to stick together very loosely and produce a highly porous substance, to which the name of "spongy iron" has been given. Next, he turned his attention to the application of iron to domestic filters; and it is important to note that the principle on which iron acts upon impure water is totally different from that of any other filtering substance. It does not, in fact, act as a filter at all, but it is slowly dissolved by the water, forming carbonates and low hydrated oxides, which pass into a higher state of oxidation at the expense of free oxygen in the water, or of oxygen taken up from the air by the water after its passage through spongy iron. The precise action is not well understood, but it depends, speaking broadly, upon the instability of the lower oxides of iron, and upon the absorption of the free oxygen in water.

The tendency to combine with free oxygen is probably one of the causes of the destruction of animal and vegetable life which undoubtedly takes place in water purified by iron. It is well known to those interested in aquaria, that water which has been in contact with metals, and especially iron, is not suited to many kinds of fish; hence the pumps used have glass barrels, and the pipes and other parts exposed to the water are made of ebonite. Again, to agriculturists the presence, in the soil, of protosalts of iron, such as are formed by the action of ordinary water upon spongy iron, is a sure sign of sterility of the soil.

In combining with the free carbonic acid in the water, iron

* 'Journal,' R. A. S. E. 1875, vol. xi. p. 127.

acts in the same way as lime in the well-known Clark process; the carbonates of lime and magnesia held in solution, in consequence of the presence of uncombined carbonic acid, are thrown down, and the water by that means is very materially softened.

In domestic filters of ordinary construction, and indeed in all but spongy iron filters, the impurities are separated by mechanical action, and they become concentrated within the substance or on the surface of the filtering medium, where germs of all kinds find a favourable breeding and feeding ground, so that, after a short time, a filter, unless cleaned, becomes actually injurious to the water passed through it, although apparently still rendering it bright and clear, because the extremely minute organisms which are injurious to health pass freely through the filter with the water.

Animal charcoal and, to a smaller extent, vegetable charcoal, possess indeed the property of purifying water, not as mechanical filters only, but as media in the pores of which chemical reactions take place; but these substances also soon become inert, and have to be periodically revivified by washing in acids and by heating.

Spongy iron, on the other hand, from the nature of its action, does not require periodical renewal, because its substance being slowly dissolved, fresh surfaces are constantly presented to the action of the water. When used in the form of a filter, indeed, the gradual accumulation of impurities requires to be removed, in order to allow the necessary freedom of percolation; but the impurities which do collect among the iron are perfectly harmless—there is neither animal nor vegetable life.

The amount of iron dissolved is very small, depending on the quality of the water. It is less than one-tenth of a grain per gallon, or one-seven-hundred-thousandth part by weight of the water operated on.

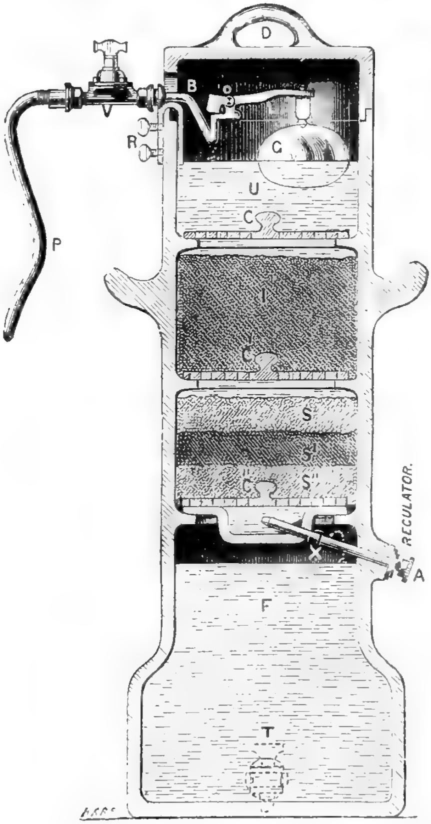
The process of purification is of a twofold character. First, the water must be acted on by the iron, and afterwards the iron taken up must be separated from the water, and the free oxygen which had been absorbed must be restored to the latter. It is well also, when practicable, that the gross mechanical impurities should be first separated by ordinary mechanical filtration.

In domestic filters (Fig. 1, p. 684) Professor Bischof has arranged the whole process in a most ingenious and perfect manner in a single vessel.

First, if the water to be filtered contains much suspended matter, comes a preliminary mechanical filtration, a layer of sand being placed on the top of the perforated plate, C, then the contact with spongy iron, I, and the final abstraction of the iron, and oxidation by means of a mineral called pyrolusite, S,

the native peroxide of manganese, which rests on a substratum of sand and gravel.

Fig. 1.—*Section of a Filter with Ball-cock complete.*



B. Ball-cock.

U. Unfiltered water.

V. Screw-valve.

I Spongy iron.

S, S′, S″. Prepared sand.

F. Filtered water.

T. Stop-cock.

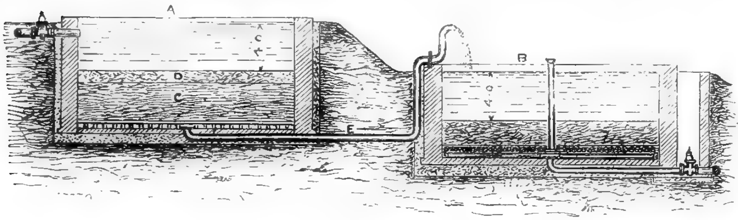
On the large scale there are two ways of arranging treatment by spongy iron.

According to the earliest method, a double set of filter-beds, A and B, Fig. 2, is constructed, one about 4 feet higher than the other.

In the upper bed, A, is deposited a mixture, C, about 3 feet deep, of three parts of gravel and one part of spongy iron, covered by a layer, D, 6 inches deep, of ordinary filter-sand. The lower filter, B, is an ordinary sand-filter, such as is used by many water companies. The water to be purified is first mechanically filtered in passing through the sand, D, laying over the iron and gravel mixture, C, through which it next

passes, and becomes impregnated with iron; it is then conveyed into the lower filter by the pipe, E, and falls in such manner as to be as much mixed with the air as possible. The iron which had been dissolved is deposited, chiefly in the form of the red oxide, and is, together with the impurities rendered insoluble, separated by the sand-filter. The purified water contains no trace of iron.

Fig 2.—*Section of a double set of Filter-beds.*



The filter-area required for this process varies, with the quality of the water, from 50 to 150 gallons per square foot of surface per twenty-four hours for each filter. The attention necessary is little more than that which has to be bestowed on all sand-filters, namely, the periodical scraping off and washing of the top-layer about one-half inch deep of sand. The mixture of iron and gravel, especially with very bad water, has occasionally to be uncovered and broken up, and the layer nearest the upper surface washed.

An instance of the application on a large scale is afforded by the Antwerp Water Works, where in 1880 Professor Bischof's method was adopted, and has continued to work with very satisfactory results ever since. After three years' continuous action there is no sensible diminution of the quantity of iron. The waters of the Nethe, which are yellow and turbid, are rendered beautifully bright, clear, and palatable, and, according to a recent analysis, the free ammonia is reduced from 0·032 grains per gallon to 0·004 grains, or to about one-eighth, and the albuminoid ammonia from 0·013 grains per gallon to 0·006, or to less than one-half. Full particulars of this application will be found in a paper by me, which was read before the Institution of Civil Engineers on January 16th, 1883 ('Proceedings' Inst. C.E., vol. lxxii.).

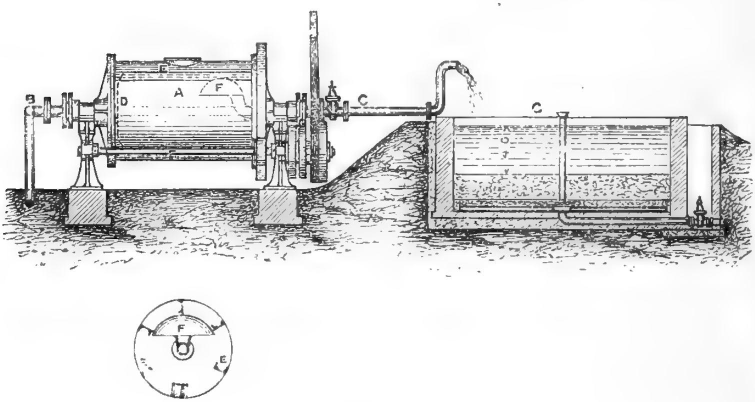
Although the system adopted at Antwerp has proved so successful, the cost of the application was very great, on account of the large quantity of spongy iron, amounting to 900 tons, required to charge the filters, the large area of land covered by

them, and the cost of cleaning entailed by the very impure character of the water operated on.

To obviate these objections, I determined to try a method first suggested to me by Sir Frederick Abel, namely, that of shaking up the water to be treated with any iron in a divided state, instead of letting it filter through it. It is obvious that, inasmuch as the object to be obtained is to expose fresh clean surfaces to the action of the water, some arrangement by which the particles of the spongy iron would keep themselves clean by rubbing up against each other would present the best possible mode of application.

The form which the apparatus has assumed is twofold.

Fig. 3.—*Section of Filter-bed supplied by Revolving Purifier.*



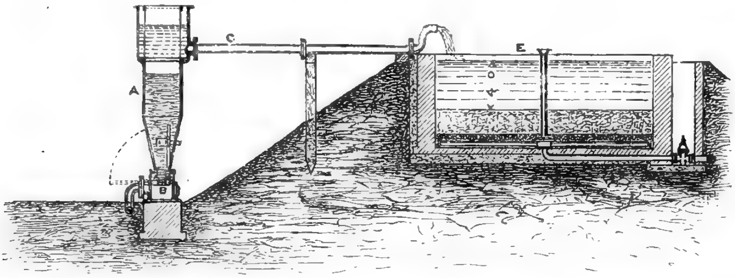
In the first, Fig. 3, the iron fills about one-tenth of a cylinder, A, revolving slowly on hollow horizontal trunnions, B and C.

The water to be purified is taken direct from the source, and passed into the cylinder through the trunnion, B, its course being checked by a spreader-plate, D; the iron is caught up by numerous longitudinal shelves or ledges, E, fastened to the inner surface of the cylinder, and is constantly showered down through the water; the rapid fall through which, combined with the attrition against itself and the surface of the cylinder and shelves, tends to keep the iron perfectly clean. The water passes slowly through the cylinder, and issues out through the trunnion, C, at the opposite end, entering it by means of an inverted bell, F, which effectually prevents any iron being carried over. The water from the revolving purifier is then allowed to flow on to an ordinary sand-filter, G, into which it should fall, so as to be

aërated as much as possible, and where the depth should be so great as to allow four or five hours before it reaches the sand. The revolving purifier requires very little power to drive it, only a few inches of head to cause the water to flow through, and it is particularly suited for large water-works, and situations where power is to be had.

The other form of purifier consists of placing the iron, for a depth of 4 or 5 feet, into a vertical pipe, A, Fig. 4, terminating

Fig. 4.—*Section of Filter-bed supplied by Vertical Purifier.*



in a cone at the lower end, like an inverted sugar-loaf. The water is forced through a jet or small aperture, B, in the apex of the cone, under a head of 8 feet or 10 feet, and issues by a lateral branch, C, at the top of the pipe. The rush of water keeps the whole of the iron, D, on the move, and consequently while the water becomes thoroughly exposed, the iron is kept perfectly clean, both by the washing and the rubbing action continually going on. After leaving the purifier, the water is poured into an ordinary sand-filter, E, in the same manner as from the revolving machine.

This form of apparatus is best suited to situations in which a fall of some 10 feet can be spared, or where pumping power exists. The purifier requires no attention whatever beyond the occasional addition of a little iron, and it occupies very little space.

The chemical effect produced is even more complete than in the case of the iron filter. Thus at Antwerp, in the water from a revolving purifier dealing with 166 gallons per minute, the free ammonia was reduced from 0·032 grains per gallon to 0·002 grains, and the albuminoid ammonia was reduced from 0·013 grains to 0·004 grains per gallon, or less than one-third.

The size of the apparatus varies with the quality of the water which affects the time of contact required. At Antwerp three minutes' contact with the iron is found sufficient; but some very bad and highly-coloured waters require as much as six minutes.

Sand-filtration is not always necessary; subsidence in large tanks or reservoirs frequently answers equally well, for the iron possesses the property of curdling together the impurities like isinglass, and causing them to subside quickly, which, before treatment, they would not do in any reasonable time.

The stock of iron required on the system described is very small; a machine to deal with 500 gallons per minute holds a charge of about one ton and a quarter, and the rate of use, including fine particles washed away in the first instance, is, with the worst waters, less than 15 lbs. weight per million gallons. The cost of the iron is about 6*l.* per ton for large quantities, and 8*l.* for small.

With respect to the effect of iron on the sanitary condition of water, it is daily growing more and more certain that the views held by Professor Bischof, Dr. Frankland, Dr. de Chaumont, Dr. J. Lane Notter, Dr. Voelcker, Mr. Hatton, and others who have examined the matter, are correct, namely, that not only does the iron oxidize or burn up obnoxious organic impurities held in solution, and therefore incapable of separation by mere filtration, and throw down salts which cause hardness, but that the germs and living organisms, both animal and vegetable, are killed, after sufficient, though by no means long, exposure.

In the interesting discussion which followed the reading of my paper at the Institution of Civil Engineers, Dr. Frankland dwelt upon the extraordinary vitality of germs and organisms exposed to the action of powerful alkalies and acids, and expressed surprise that they should be so powerfully affected by a substance so neutral as iron.

It is certain, however, that the water in the purifiers is largely deprived of its free oxygen, and the inference is highly probable that many living organisms cannot consequently exist, and are, in fact, smothered for want of air. In the revolving purifier it is necessary to provide a cock for periodically letting off the gases which collect. These gases are found to extinguish the flame of a taper instantly, and on analysis are proved to contain only $8\frac{1}{2}$ per cent. of oxygen. It is satisfactory to find, as a confirmation of the views of the eminent men above quoted, that the inhabitants of Antwerp have been free from all epidemics, although they have been for three years supplied with water taken from a most offensive and discoloured tidal river, a river which flows through and drains a highly-farmed country, and which takes the sewage of several large towns and many villages.

There is no doubt that, by adopting purification of water by spongy iron, almost any source can be made thoroughly fit for

dietetic purposes, and the effluent water of sewage purification and sewage farming can be made not only unobjectionable, but a decided gain to the stream into which it may flow. It may further be remarked, that freedom from colour, brightness, and palatability of water are no evidences of its purity in a hygienic sense. It has been shown over and over again, as for instance at Caterham during the epidemic of typhoid in 1879, that such waters have held the germs of deadly diseases; but it is almost equally certain that, after treatment by iron, they become perfectly safe and wholesome—in fact, the process of purification by iron is a guarantee of the fitness of any water for the use of man.

XXIII.—*Report of the Senior Steward of Implements at Shrewsbury.* By Lord Moreton, M.P., Senior Steward.

In writing the customary Report which is required from outgoing Stewards, I need not enter into any detailed account either of the mechanical novelties exhibited at the Show or of the Trials of Sheaf-binders which were held afterwards; both of these subjects will be dealt with in the next number of the 'Journal' by the able pen of Mr. Thomas Bell.

I am glad to be able to congratulate the Society on the success of this year's Show. They were extremely fortunate in the Showground, in the weather, and in the crowds who thronged the ground. I hope the financial result will not lead the Society to regret that, after an interval of thirty-nine years, they revisited the ancient town of Shrewsbury.

The Working Dairy was again an object of great interest to visitors. This year a change was made in this department, horse-power being substituted for steam, to demonstrate that expensive steam machinery is not an absolute necessity in this important branch of farming. The unfortunate accident (happily not so serious as it at first appeared) to one of the dairymaids cast the only cloud over what was otherwise a most fortunate week.

The Trials of Sheaf-binders were held in August, a few miles from Shrewsbury, and lasted a week; during this time the weather was all that could be desired, indeed, those whose duty required them to walk behind the competing machines will not soon forget the intensity of the heat. Although the trials did not prove very attractive to the general public, it would be difficult to overrate their importance, being perhaps the most

thorough that this or any other Society has ever held. The awards of the Judges were:—

Section I.—Sheaf-binding Machinery.

Class 1.—First Prize of 100*l.* for a Sheaf-binding Reaper, the binding material to be other than wire: awarded to Messrs. Hornsby and Sons, Limited, for No. 4568.

Second Prize of 50*l.* for a Sheaf-binding Reaper, the binding material to be other than wire: awarded to Messrs. J. and F. Howard, for No. 47.

Class 2.—Separate Sheaf-binder, the binding material to be other than wire. Prize withheld.

Section II.—Ensilage.

We have carefully tried the whole of the machines entered in this competition; we have not found any single machine that completely meets the condition under which the prize was offered, viz. for an efficient machine for cutting and elevating materials to be preserved in silos. We consider, however, that Messrs. Richmond and Chandler's machine, No. 1630, is deserving of high commendation for the efficiency of its arrangements for cutting the materials.

Miscellaneous.

Silver Medal to Burlingham, Innes, and Paternoster, Stand 87, for new patent self-feeding motion attached to Article No. 1709, as an efficient safety guard to the feeder of the machine.

Silver Medal to Richard Hornsby and Sons, Limited, Stand No. 262, Article No. 4606, for Plough marked L. M., fitted as a gripping plough, with steel breasts.

Thomas Bell.
Mason Cooke.
Wm. Scotson.

I should like to take this opportunity of urging upon all exhibitors of implements the desirability of making a point of reading over the rules of the Society every year when making their entries. Many exhibitors seem to take it for granted that the rules and regulations relating to the exhibition of implements are never altered, thereby giving themselves much unnecessary trouble, and adding very considerably to the work of the Stewards.

In conclusion, I must heartily thank my brother Stewards and all others with whom my work has brought me into contact, for the unvarying kindness I have experienced at their hands from the time I entered upon my stewardship at Reading till now, when I step aside and make way for my successor.

XXIV.—*The late George Turner.* By JOHN CHALMERS MORTON, Editor of the 'Agricultural Gazette.'

THERE is not much of incident to be recorded in the quiet life of a home-loving countryman, however active and public-spirited he may have been. When one has spoken of industry and enterprise and success upon a farm; of activity as a Guardian of the Poor, as a Churchwarden, perhaps as a Magistrate, or as a member of a Highway Board; of kindliness, good sense, and friendship as a neighbour; of pursuits outside the mere business of agriculture—country sport, political activity, and the few other relations with the outside world which such a life possesses—the story is complete.

So old a Member of the Society, however, as Mr. George Turner,* and one so well known both in its Council-room and in its Showyards, ought not to pass away without some reference to our loss, in the pages of our 'Journal.' In Mr. Turner's case the agricultural side of the memoir dominates the whole. A thorough countryman, he was energetic as a farmer—hearty, serviceable, and kindly as a neighbour—keen and clever as a sportsman: he had been especially useful as Chairman of the Highway Board of his district: he was traditionally loyal to the political party with which his family had been long connected, and so good a countryman was a first-rate county canvasser for his party: and his advice and help were invoked and gladly accepted, not only by the political leaders who appeared upon the scene at intervals, but constantly by neighbours of every degree. It was through the Royal Agricultural Society and its Council Chamber and its Showyards that he at length became known to his brother farmers generally. Looking back through the now long series of annual records, one finds his name as taking first prizes for Devons "bred by himself" so long ago as 1840 at Cambridge, and he was first at Shrewsbury in 1845 for his "pure Leicester sheep." Both flock and herd thus entered on a long career of success: and there is a certain wistfulness in the feeling with which, in the earlier volumes of the Society's 'Journal,' one who has attended nearly all its Meetings from the first reads the constant succession of awards to the same old name, beginning so early in the history of the Society, and continuing so long.

Mr. George Turner was the second son of Mr. John Turner, of Cadbury, Devonshire. He was born in 1793, and educated at Tiverton; and after living for a year or two at home, he

* Mr. Turner was one of the original Members of the Society—elected in 1838; and he had been a Member of the Council since 1845.

early took charge of a farm in his own neighbourhood, from which, three years later, he migrated to a larger one at Barton, near Exeter, of which he was the tenant during the greater part of his active life. Holding ultimately 350 acres there, some 200 acres at Halescombe, smaller outlying farms elsewhere, and upwards of 200 acres at Great Bowley, which was the family property, he had at one time nearly 1100 acres in hand, giving ample scope for all the agricultural skill and energy at his command. His reputation as a farmer rests chiefly upon his herd and flock, of which the credit must, for the most part, be attributed to his own skill as a stock-breeder. The flock was, however, to some extent selected by the father, who during many years used to take an annual journey on horseback into some of the eastern and midland counties, and on some of those occasions brought back with him sheep from the flocks of Mr. Burgess and other well-known Leicester breeders, paying occasionally prices for rams rivalling the highest prices now reported.

Mr. Turner's reputation as a Devon breeder hinges probably, to some extent, on the herd handed down to him in the outset of his career; but latterly, of course, and for half a century and more, he had depended on his own skill in selection from the material at his command. How great that skill was is proved by the successes achieved at almost all the annual Shows of the English Agricultural Society and those of the Bath and West of England Society. From 1840 onwards the Barton flock and herd won prizes at the annual Shows of the Royal Agricultural Society; and when the Bath and West of England Society held its Meeting at Dorchester, of the thirteen cattle and sheep sent, every one received a prize. From a list before me I see that two first prizes were won at Cambridge and Liverpool in 1840 and 1841; four, three, four, and three at the succeeding Meetings at Derby, Southampton, Shrewsbury, and Newcastle; no fewer than five at Gloucester, four at Lincoln, six at Carlisle in 1853, 1854, and 1855; and as many as eight at Canterbury in 1860.

He exhibited also at the International Show at Paris, where, with Jonas Webb, he shared the honour of conducting the Emperor and Empress round the English classes. He both took prizes there, and sold the animals he exhibited. He had, indeed, received more than five hundred prizes in all during his career. This unvarying success was of course due not only to good judgment and skill in the selection of animals, but to constant carefulness and industry in the management of the farm. One of his most noteworthy characteristics was his constant industry and activity, shown both on the farm and off it. After a long day spent, whether in sport or in the fields, there was no listless evening, but earnest occupation—reading,

correspondence, or accounts—engaged him. And though I have no report to give of his farming apart from the successes of his stock, yet one so energetic certainly did not fail to make the land produce its utmost for both man and beast. Mr. Druce speaks of the attention he devoted to the catch-meadow system of irrigation, by which in Devonshire early green food is provided for the flock. And at the Exeter Meeting of the Royal Agricultural Society in 1850 a large party were welcomed on his farm, to whom he explained and illustrated the process, letting the water on roughly and out of season for the purpose.

Mr. Turner left the Barton farm some twenty years ago, owing partly to political differences with the landowner; and, retiring to Great Bowley—a smaller occupation, his own property—his business thereafter was to some extent restricted. Still, however, his Devon cattle and his Leicester sheep were annually sent for almost invariable success, until—his sons leaving him, for the Church or the army, or for agricultural occupation in another county—he at length concluded, not, however, until he was past eighty years of age, to give up business. The sale of his stock took place in 1881, at a period of great agricultural depression, when, of course, they did not realise such prices as he had obtained for them annually before. Both Devon cattle and Leicester sheep are less distinctly in the front rank among competing breeds than they used to be; and it was with something of a disappointment that a long agricultural career was brought to an end. Not, however, that honours had been wanting of a kind most likely to give him great pleasure. He was elected an honorary Vice-President of the Bath and West of England and Southern Counties Association, and he had received a very handsome gift of plate from his neighbours on leaving Barton, on which the following words were inscribed:—"To Mr. George Turner, of Barton, in testimony of the sense his numerous friends entertain of the important benefits he has conferred on the Western Counties by his persevering and successful efforts to improve the breed of cattle, and his spirited and liberal conduct for the advancement of the agricultural interest in all its branches."

Mr. Turner retained his warmth for the agricultural interest till the last. I had the pleasure to receive from him one of the latest letters on public affairs he can have written. It was dated June 28 of last year, and was written in answer to a request for information on the promise of that year's harvest. "I send you," he said, "my opinion of the prospects of agriculture in this neighbourhood; and my great age (within two months of ninety) must be my apology for any mistakes that

I may make;" and then follows a rather hopeful account of the yield in Devonshire last year. Nor does he bate one jot of hope, or even confidence, for British agriculture generally. "I have just heard," he says, "of a letter received by a neighbour, from a man who emigrated from an adjoining parish to this two years ago, wherein he says that beef is from $10\frac{1}{2}d.$ to $14d.$ per lb., and bacon and lard $9d.$ in America, so that importations of meat will not ruin us." The quotation is made, not for the likelihood of the American report, but for the insight which it gives into the heart and strength and hopefulness of a veteran agriculturist. "Lean cattle are selling very high, and leave but little margin for the grazier. Sheep are also dear, but wool low. Pork cheap, but the mechanics will not eat it because it is so. The labourers are better off than ever, having high wages and a cheap loaf.

"I enclose a copy of a letter of mine," he adds, "to the 'Western Times' of Exeter, which you can do as you please with. I do not now attend the Council of the Royal Agricultural Society, of which I am by twenty years the senior member, being the only one left who helped (in my parish) in my humble way, to form it with those great and good men, the late Duke of Richmond, Lord Spencer, Messrs. Handley, Pusey, Hobbs, Ransome, &c.; and I had been an exhibitor up to 1881, having won nearly 600 prizes from different societies; but I am now content to criticise other judgments."

His letter to the 'Western Times' is quite worth reproduction here, both for the portrait of himself which unwittingly the writer gives, and for the good advice with which it ends:—

"I quite agree with Lord Ebrington that the British farmer has nothing to fear from the importation of animal food from Australia, nor do I think from any other country. I also believe that you will never see beef and mutton lower than at the present time, nor will you ever see wheat at a higher average price than at present; and I will briefly state my reasons for thinking so. In the first place, our population is increasing at least 500,000 a year, every one eating more animal food; next, we are 6,000,000 deficient of sheep; 2,000,000 acres of poor land are out of cultivation already, and 200,000 of the best are taken up by railways. I have farmed (sometimes largely) for sixty-five years. At the beginning I got more manual labour done for one shilling than I now get for two, and if the poor land only just paid at the time, when the produce sold at one-third more, it must be worthless now; and all the thin-skinned soils that won't grow grass are dear at any price. But I firmly believe that the best land in a short time will be worth more than ever it was, and that we

shall have a difficulty in finding animal food sufficient for the people.

"With wheat it is very different, as it is very easy of transit, and will be brought from all parts of the world, let the price be what it may. I have some relatives in California, where they harvest, thresh, and winnow their wheat in the field without rain, place it in sacks on the quay at the harbour, and wait until the vessels come and take it away. If the labourer has only to pay 6*d.* for his loaf instead of 9*d.*, the remaining 3*d.* will go for meat. My advice to my brother-farmers is —'Grow as much beef and mutton as you can, and as little wheat.'"

It was to the herd and flock that Mr. Turner wisely looked for any way out of our present difficulty that may be possible. It was through the herd and flock that his own great contribution to the agricultural improvement of his day was made. "He had, in my opinion"—I quote a letter with which I have been favoured by Lord Bridport—"the best herd of Devons in 1862 of any Devon breeder. In that year he left Barton, but continued in a smaller way to breed cattle and sheep, maintaining his reputation as a successful exhibitor until the last few years of his life. I may mention that when His Royal Highness the Prince Consort established a herd of Devons in Windsor Great Park, many of Mr. Turner's contributed to form it."

With some particulars of this herd, as the reputation of many successors rests upon it, I conclude this short memoir. The following notes by the experienced hand of Mr. W. Housman were written some years after Mr. Turner had left Barton. They were published in the year 1870 in 'Bell's Weekly Messenger.' "It is now" (1870), he says, "more than fifty years since Mr. Turner began to breed Devons. The first portion of his stock was inherited from his father; and to that he added, by purchase, infusions of the best 'Quartly' and 'Davy' blood obtainable, together with some good material derived from the herd of Mr. Halse. Amongst the bulls used by him in recent years, 'Albert Victor' (776) holds a prominent place in his estimation, as a most valuable and strongly impressive sire. He was bred by Mr. Turner himself, from his cow 'Vaudine,' a winner at the Royal and Bath and West of England Shows. The sire of 'Albert Victor' was 'Leotard' (866), a son of 'The Little Known' (733), whose descent in the maternal line (pure 'Quartly' blood; he was bred by Mr. John Quartly) traces to the Bristol 'Royal' first-prize cow 'Prettymaid,' and the celebrated 'Curly' family of the late Mr. Francis Quartly. The male line of 'The

Little Known,' taking, we mean, the succession of sires, is one of peculiar splendour. 'Napoleon' (259), a mediate sire, distinguished himself at the 'Royal' and Bath and West of England Shows; 'Duke of Devonshire' (35), 'Napoleon's' sire, was a 'Royal' first winner; so was *his* sire, 'Baronet' (6), and 'Baronet's' sire, 'Quartly's Prince of Wales' (105); 'Prince of Wales's' sire, 'Prince Albert' (102), was a winner at Barnstaple; and 'Prince Albert's' sire, 'Hundred Guinea' (56), won the 'Royal' first prize in the Aged Class at Bristol. Our Devon readers know very well that 'Hundred Guinea' was a son of the prize-winning 'Sillifant' (120), and that his blood on both sides was derived from the patriarchal 'Forester' (46), whose potent and favourable influence upon the Devon race is so notorious among the initiated in Devon history as to make the name of 'Forester' one of the most familiar of their household words. 'Albert Victor' creditably followed the lead of his ancestors, winning at the 'Royal' Show first prizes at Plymouth and Leicester, on the former occasion as a calf, in the latter Exhibition as an aged bull. He was also the winner of a first prize at Falmouth (Bath and West of England) in 1868.

"Mr. Turner's present herd may be divided into three leading general sections, of which his 'Lady' tribe is one; the second comprises the 'May Dew' family and others; and the third is composed of 'Duchesses,' eight or ten in number. Besides these, he has three recently purchased at the sale of Mr. John Quartly's Devons. Mr. Philip Halse, of Molland, bred 'Duchess 1st,' the first-prize yearling at the Canterbury Royal, and now a fine true-framed old cow of twelve years. The rest of the 'Duchess' family Mr. Turner himself bred. 'Duchess 2nd,' a daughter of the old cow, was by Mr. James Quartly's 'King of the Bretons' (659), the son of 'Napoleon' (259) mentioned above, and inheritor, therefore, of the same grand paternal ancestry claimed by 'The Little Known.' It is worth notice that the sire, as well as the dam of 'Duchess 2nd,' was a first-prize winner at Canterbury; and 'Duchess 2nd' is herself in every way worthy of her parentage." Breeders of Devon Cattle will probably thank the editor of the 'Journal' for permitting this reference to the history of Mr. Turner's herd, from which many of their own best strains have sprung.

There is little more to say. Mr. Turner, as his letter quoted above, written in his last year, abundantly proves, retained his warm interest in agriculture to the last. I have before me a memorandum, in his own hand, of a journey made in 1877, to his friend Sir Thomas Boughey, of Newport, Shropshire, in which the home farm there is described as the cleanest and best

managed he had ever seen, and the home herd as "the best eighty Devon cattle in England;" and the farming notes of what he saw on the way up and down are as hearty, bright, and incisive as he could have written had he been fifty years younger.

Mr. Turner was one of a family who had settled in Devonshire from time immemorial, and in the parish of Cadbury, on the family estate, for two centuries and more. He thus was thorough Devonshire, and is well designated in a newspaper notice of his final sale:—"George Turner, a worthy successor of Arthur Young, of Bakewell, and of Coke, who has made Devon famous in the agricultural world."

The end was not long delayed. Born on August 1, 1793, he died on June 1, 1884. Strong-voiced, resolute, and whole-hearted to the end, the gallant old gentleman had ridden the whole run with the hounds, a ten-mile point, coming in at the death of the stag, so lately as 1876, in the eighty-fourth year of his age. He had retained the management of his home-farm throughout, without any help or interference. His broad-brimmed white hat had been conspicuous for sixty years and more wherever countrymen gathered, whether in market-place, in Showyard, or in the field; and there was hardly a grey hair under it even at the last. "Turner," he once heard a whisper in the midst of business at the Council table, on the occasion of one of his last attendances, "what hair-dye is it that does so well with you?" "Temperance, my lord," was the prompt reply; "you just try it!"

Mr. Turner is worthily succeeded in the agricultural world by his second son George, who occupies the farm of Thorpelands, near Northampton, where the pure Leicester flock is still in existence, and whence it is annually sent to take prizes in our Showyards. He had followed there another noteworthy agriculturist, who has long since passed away—Mr. Clarke Hillyard, whose book on the practice of farming stands first upon the list of donations to our Library (see 'Journal,' vol. i. 1840), and whose white head and ready tongue I well remember many years ago as he descanted on the merits of the prize Devon ox with which he had just taken the Gold Medal of the Smithfield Club. Mr. Turner's eldest son is the Rev. W. B. Turner, of Braywood Vicarage, near Windsor. Another son is in business in Manchester; and his fourth son is Major Turner, of the Bengal Staff Corps.

XXV.—*Reports of the Honorary Consulting Entomologist.* By Eleanor A. Ormerod, F.R.Met.Soc., Dunster Lodge, Isleworth, near London.

May, 1884.

The Hop Aphis.—I have pleasure in being able to report that serviceable information has been sent in during the spring regarding the first appearances of the hop aphis.

These have been observed both on the first shoots of the hop, and on damsons, in the condition of wingless females, depositing living young, commonly called "lice." The specimens which were forwarded to me from hop-shoots were of the true hop aphis, *Aphis* (*Phorodon*) *humuli*, those from the damson I consider to be of the variety of the hop aphis, known as the *Aphis* (*Phorodon*) *humuli*, var. *Malaheb*, which is the kind or variety which is believed by many observers to spread on the wing from damsons and sloes to hops.

The first specimens of these "damson-hop" aphides were forwarded to me on damson-buds, from Kent, on the 25th of March, and the lice on the shoots sent were numerous.

On the 29th of March lice of the hop aphis (of which specimens were forwarded) were found on young shoots of hops on many hills in a "Grape" hop-ground at Barming, near Maidstone, by Mr. Whitehead, and in most cases where the small lice were observed, a large active wingless viviparous female was also observed near them. Shortly after the above date more lice were reported from the same hop-ground, and they were also found by other hop-growers near Maidstone. On the 31st of March "lice" were found on "Grape" hops at Wateringbury; on the 1st of April they were found on young shoots at Crouch, near Sevenoaks, and on the 14th of April wingless females were observed, after careful search, in a hop-ground near Hereford.

We have thus clear proof of attack, beginning in various localities by means of the deposit of lice by wingless females, which females it appears impossible to suppose have arrived on the young hop-shoot by any other means than that of walking up from the hill, be it out of the ground, or out of the hop contained in it. I have therefore suggested the application of such dressings to the surface of the hill as might be likely to poison the wingless females, or at least keep them from crawling up through matter, which should be obnoxious to them, but at the same time not be hurtful to the surface rootage, or to the young hop-shoots pushing up through the application.

Experiments on this point are being carried on with lime, lime and salt, and also with ashes sprinkled with paraffin; and I am myself trying the effect of spent gas-lime (that is gas-lime which has been exposed for about eight months), applied as a thin layer on the ground, around the pushing shoots, and I do not see that any injury has been caused by it.

With regard to the attack which is considered (and, as far as I can judge, with much reason for this opinion) to come on the wing later in the season to hops from damsons and sloes, there is great need of more precise information, and it would be very desirable to have specimens forwarded for minute examination as soon as the "fly" appears on the upper part of the hop shoots.

The true hop aphis, the *Phorodon humuli*, is well known, and under the microscope is distinguishable by the lowest joint of the horns being bluntly toothed or gibbous, and also by the tubercles on the forehead having a tooth on the inner side.

The *Phorodon humuli*, var. *Malaheb*, is recorded as being found on damsons, sloes, and plums, and is considered by many qualified observers to migrate from damsons, &c., to hops—therefore to save trouble I call it here the "damson-hop" aphis. This much resembles the true hop aphis, but is described scientifically as not having the tubercles on the forehead so much developed as in the case of the wingless viviparous female. There is great difference of opinion as to which genus of aphides this kind should be placed in, and from specimens sent me I incline to think that the characteristics, so far as amount of forehead tubercle are concerned, are very variable, but it may be distinguished from two other kinds which often infest plums or damsons as follows. The viviparous females are *green*, whereas those of the *Myzus cerasi*, often found on cherries and plums, and of which the pale lice in their early state much resemble hop-lice, are wholly *black*, saving an occasional clouding with green.

The *Aphis pruni*, or common plum aphis,* is, as far as I see, always without frontal tubercles. I mention these points as some guide to observers who wish to enter on them, but at the same time beg to submit that what we most urgently want just now is plain practical experiment. It is certain that hop-lice (irrespective of their scientific names) have been clearly seen in many different localities, being deposited by wingless females, and it is of some importance to notice that these were first observed by a well-skilled grower, but (though numerous) had

* The above characteristics are mainly taken from the 'Monograph of British Aphides,' by G. B. Buckton, F.R.S.

not been noticed by the labourers; and the other observations sent to me were by qualified observers after special search.

I therefore submit that it is likely that the wingless females were depositing lice as freely in many places where they were not observed, and that *now* is the time, if not already too late, to check a large part of the coming attack.

Attack may very likely come later in the season on the wing, also it is very likely that the circumstance of these females depositing living young so early in the season may be unusual, and an effect of the very mild winter. But in any case, now they are at work, it is of great importance to check attack, and any experiments, even if only applied to two or three hills, to find how to clear off what are on the shoot, or to prevent more creeping up out of the hills, would be of great service, and if on a larger scale, of proportionate value.

Attack of Grubs of Daddy-longlegs.—This has been reported as occurring to a very injurious extent to corn crops after clover ley, and broken up grass pasture, and also in grass, at various localities both in England and Ireland. From the great number of the flies which were noticeable in the autumn, it appeared likely that such would be the case (see 'Journal of Royal Agricultural Society,' 1884, part 1, p. 325), unless means were then taken to prevent attack. For measures to carry the young corn over the attack, as far as can be done now the grub is present, I am advising the use of fertilisers, and also rolling with the Cambridge roller, or Crosskill's clod-crusher; for although rolling by day is not at all certain to kill many of the grubs, as they are not then on the surface, it consolidates or "firms" the ground, so that the grubs cannot travel freely from one plant to another.

The grubs dislike light and heat, and come on the surface at night, and, in examinations lately made, were found in great numbers on the surface of the infested field at 1 A.M. From this and other observations it appears that if the heavy rolling could be applied after sunset, or before sunrise, that a much larger number of grubs would be destroyed. Experiments regarding this point have been promised on badly attacked land in Devon and in Lincolnshire, and the results will be reported.

For fertilising applications I am suggesting a mixture of guano and salt, applied at the rate of 4 cwt. the acre; or of a mixture at the rate, per acre, of guano, 1½ cwt.; salt, 2 cwt.; and kainite and superphosphate, 1 cwt. each.

Either of these mixtures has been found useful in checking attack, and as guano has been found to injure some kind of insects, and salt helps to make the surface tenacious, there appear to be reasons for their good effect, besides the manurial

properties. But as the expense of dressing is very heavy, I may add I have had notes of failure of effect from the following applications, namely:—of salt, at the rate of 3 cwt. the acre, over a 17-acre field; of heavy dressing of soot to 3 acres; of quicklime to 4 acres; and a dressing of salt of 2 tons, mixed with half a ton of nitrate of soda, on about 12 acres of land, did not kill the grubs, though it thinned them.

Where the crop has been so totally destroyed that re-sowing was necessary, I have replied to enquiry on this point, that it would be mere waste of money to sow till the grubs were cleared; also I have suggested that scarifying the surface, so as to turn up the leather jackets to the birds, would be better than ploughing, as these grubs can stand want of all food, excepting what they may obtain from the earth, for certainly three weeks, and would gradually work their way up without having been injured.

I have not as yet advised hand-picking to clear infested ground before cultivation for re-sowing, but I fully believe that where the grubs are to be found (as sometimes is the case) as numerously as upwards of thirty just below the surface in two feet in a drill row, that it would answer thoroughly to have them collected at some small sum per stated measure.

Notes have not been as yet sent in of the effects of nitrate of soda used alone; but as I have found on experiment that the immediate effect on the grub was to make it entirely evacuate all its contents, it might very likely act as a deterrent as well as a fertiliser. Mixed with dissolved bones, it has proved serviceable in raising good grass free from attack where the ground had been re-sown after attack. I have also found a light sprinkling of gas-lime, which had been exposed upwards of a month to air, useful in preventing attack being set by the daddy longlegs' flies when present on grass, and for autumn use a heavy dressing of spent gas-lime on grass, or fresh gas-lime where the land is to be broken up, answers well.

Injury to Osiers.—An enquiry of some importance has been sent from Northallerton regarding injury to shoots or stocks in osier grounds from the attack of a red maggot, nearly allied to the red maggot of the wheat, which proved (as far as could be seen in this stage) to be the larva of the *Cecidomyia saliciperda* of Dufour.

The grubs are oval, legless, and orange coloured, and furnished with a dark-coloured horny four-pronged process, placed below the head. These grubs lie in small cells (which they have scraped for themselves in some way, and I rather think, from examination, by the help of the above process) just beneath the bark or within the wood of the shoot, and in the specimens sent

these cells were placed so closely side by side, that sometimes the whole surface beneath the bark was pitted with them, and in all cases the bark was so completely loosened and destroyed for a length of some inches, that it was peeling off in ragged flakes, and consequently the shoot above would certainly perish.

The grubs were (about the middle of April) turning to chrysalids in their cells; these chrysalids are of a bright scarlet colour, and show the shape of the future gnat midge, and are peculiar from having two upright horns, or sharp somewhat triangular ear-like processes on the head. The midges come out about the beginning of May, and are in shape much like the wheat midge (figured in the 'Journal' of the Society, part i. 1884, p. 329); the colour is of various shades of brown or grey.

The best way to prevent the renewal of attack is to remove all the infested shoots from the osier ground, early enough in the year to ensure the grub being carried off in the sticks, or destroyed, by burning the pieces that are absolutely worthless, before the time comes when it will develop to midges. The beginning of April would be quite early enough for this, and where, as in the instance reported, the osiers are spring cut, there would be little loss or difficulty in this treatment. Shoots left, on account of smallness for cutting, to run to a second year appear particularly liable to attack, plainly in consequence of being present in order for egg-laying, when the midge develops.

Other applications have been sent to me relating to crop pests and measures of prevention of insect injury, both home and colonial, to which I have carefully attended. Some information has already been forwarded in reply to the Society's circular regarding maggots in manure. This at present chiefly refers to daddy-longlegs grubs.

These have been found in cattle-droppings on pasture land; also in very large numbers in rotten turf which had been cut and piled in the autumn; and also with other grubs in decayed weeds and other vegetable matter left heaped during winter for experiment.

Full details of these and other observations in progress will be given in due course. I have forwarded about 300 of the Society's circulars to observers, and have reason to hope for some serviceable returns.

The Warble Fly.—I beg further to submit that my attention has been directed to the yearly injury to horned cattle, and the depreciation in the value of hides caused by the attack commonly known as "warbles."

From careful study of the history of the ox bot-fly, or warble-fly—the *Œstrus* (*Hypodermus*) *bovis*—joined to the recent experiments made by Mr. Stratton, there does not appear to be any doubt that from the time that the first ulceration takes place, by which an opening is formed into the coming swelling, that the maggot within can be rapidly and surely killed, with little trouble or expense.

In Mr. Stratton's recent experiments, the simple application of a little mercurial ointment, placed on the orifice, killed the maggot. A little arsenite of copper (commonly known as Paris Green, or Scheele's Green) likewise killed the maggot, but caused some slight inflammation; and a little pitch served the same purpose, excepting in one instance, where the maggot was not quite certainly dead on examination. The mercurial ointment acted the best, as it not only killed the maggot, but rapid decomposition followed.

These applications were tried when the warble was in the advanced stage it attains in spring, but would, as far as we see, act equally well as early as about October of the previous year. The warble-fly deposits her egg during the summer, and the maggot, which takes its position within the lower layers of the hides, is at first quite smooth in its skin, and lies without causing noticeable harm, and also, as far as is known, without communication with the air; but afterwards (at its first moult) it gains a skin set with patches of minute prickles, by means of which irritation, and then ulceration, is set up, and the opening formed.

This takes place towards autumn, and by passing the hand along the back and loins of the cattle, the warble may be detected as soon as it is as large as a nut; and early attention would be of great service to the cattle, and further is of great importance relatively to saving loss on the warbled hide.

At first the cavity is very small, and whilst it is still only a small sore, healing will readily take place on removal of the cause of irritation; but after some months, when the maggot has nearly attained its full size, it has been found, by the observations of German anatomists, that a growth which much resembles that of the various layers of true skin has formed over the inner surface of this maggot-inhabited hole in the hide; consequently, when the maggot has left it, although the cell may draw together, there appears good reason why the already healed surfaces should not unite.

Other points in the habits of the fly may be brought to bear on reducing the amount of attack, and when it is advanced, such methods of action as pricking the grub, or squeezing it from the warble, will destroy it; but the measures needed are those

which can be applied easily, and so early in the progress of the attack as to save the winter presence of the grub, and I believe that going over the herds once or twice in the autumn, and supplying a little mercurial ointment, would easily and surely meet this point.

But although the entomological part of the attack is plain, still it involves questions of cattle-treatment with which I am not fully competent to deal, and I therefore submit my views respectfully for consideration, and shall be happy to give full details of the life-history and habits of the warble-fly, if wished.

July, 1884.

I beg to report that during the last two months I have received about twenty communications regarding methods of prevention of insect-ravage, and points bearing practically on this subject.

These have been mainly with regard to warble-fly on cattle, daddy-longlegs' grubs, wireworm, willow-beetles,—which have been seriously injurious in Cheshire,—and beet-carrion beetle, an unusual attack, which was reported from Mageney, Kildare, Ireland; and also many communications on the subject of hop aphis, which is proving a most serious trouble this season; and communications regarding practical instruction bearing on the prevention of insect-ravage.

Inquiries regarding the name (and treatment of attack) of many other insects have been sent in; but as many of the observations are in progress, to be brought forward more completely, with illustrations, in the autumn report, I beg leave now only to enter on some points possibly serviceable for present use.

The appearance of the beet-carrion beetle (*Silpha opaca*, Linn.) has been considered, on the few occasions when it has been recorded in these islands, as very probably taking place in connection with the mixture of what is described as "garbage" with the farm-manure—that is to say, the mixture of dead animals, or portions of them. This beetle and its grub infest putrid animals, but the grub is also occasionally destructive to mangold-leafage.

The grubs when full grown are nearly half an inch long, blackish, and remarkably like wood-lice in shape. The beetles are not so long, are very flat, and of a squarish oval shape, and brown-black in colour, and may be known by the edges of the wing-cases being turned up, and by having a raised lump between the two outer of the three ridges that run down each wing-case.

As the recorded attacks of the grub do not appear to have extended beyond from about May 20th till the latter end of June, this is one of the cases in which stimulating dressings, such as nitrate of soda, superphosphate, or other applications which will keep up the growth of the leafage until the grub has left it, are particularly serviceable. Also care should be taken not to plough up a crop damaged by this grub too soon, for if the centres are left in the mangolds when the time for the grub to change comes, the plants may very probably, in the end, turn out little the worse for the temporary attack.

Attack of the mangold-leaf maggot is now beginning; and in this case also (when attack is set up) almost the only serviceable treatment appears to be the application of stimulating dressings suitable for encouraging an immediate hearty growth. Nitrate of soda seems to do best; but guano, superphosphate, or any rapidly acting fertiliser, would probably act as well. Pinching out the blister with the maggot in it, or drawing the maggot-infested plants and destroying them, does good by preventing the second attack, which would have arisen from these maggots (when they left the leaves) turning to chrysalids, and thence to flies; but for the time being this treatment does almost as much harm to the leafage as the mining of the maggot.

It would be very useful if notes were sent in whether this attack was prevalent on land which had been autumn, rather than spring cultivated.

Attack of hop aphis is becoming very threatening. Many communications have been sent in, accompanied by specimens, which I have carefully examined microscopically, and in many cases figured, as far as requisite, with a view of showing in the autumn report the points of difference between the true "hop aphis," *Phorodon humuli*, and the true "plum aphis," the *Aphis pruni;* and likewise the kind (whether a different species or only a variety) scientifically known as the *Phorodon humuli*, var. *Malaheb*, but which, from being found both on hops and damsons, may be conveniently called the hop-damson aphis.

With regard to the origin of attack. It began on the hops very early this year, by means of wingless females coming up from the hills and depositing live young. So far as this first attack goes, it appears to me it might be prevented by practicable treatment.

In the acre of trial ground at Stoke Edith, which I am permitted the use of by the courtesy of Lady Emily Foley, the hops which were dressed over the surface of the ground of their hills, early in the season, with various applications to prevent the female aphides coming up, remained clean from attack until May 26th; whereas those in the other part of the same hop-

garden were infested by wingless females and lice on the underside of the leaves. Likewise a plant isolated from all outside attack (of which the ground was treated last autumn to prevent or destroy lodgment of aphis) has remained quite clean from attack.

When the "fly" came, the acre of plants was infested by the pest on the wing like the others.

With regard to where the attack of "fly"—that is, of aphis in the winged state—comes from, there appears to be good reason to believe that it comes both from neighbouring hops, and also from damsons and sloes, which, from specimens sent to me as early as March and onwards, I find to be infested with the variety of hop aphis considered by many entomologists to infest both hops and various kinds of plums. On June 28th I received from Wateringbury, Kent, freshly gathered sloe-sprays loaded with aphides, which, after long and careful microscopical comparison with the true hop aphis, I consider to be the hop-damson aphis, *Phorodon humuli*, var. *Malaheb.*

I think, therefore, that it is very likely indeed that a portion of the attack comes on the wing from sloes and damsons, but by no means all, as there are differences in form (as far as I see) in these two kinds or varieties: and from information sent in up to this date it appears to me that if, as far as hop-grounds go, measures were taken to prevent the hills being infested when the aphides are leaving the hop-bines in autumn, or were so treated by dressings laid on them in the spring that the hop aphis *could not crawl up* through the application, that it would make a great difference in the amount of first attack, and necessarily diminish the amount of hop "fly" that would be produced on the bines.

But, further, I certainly consider that the complete removal of sloe hedges, and also, where damsons are grown, dressing over the ground beneath them as suggested above, would be very likely indeed to lessen the amount of these pests on the hops near.

In experiments which I have tried in my own garden, I have found that a good sprinkling of gas-lime in spring, on the surface of the ground through which the hop-shoots were coming up, did no harm at the time, and the plants are growing well now.

Experiments are in progress relatively to additions to the usual soft-soap washes which may be of use, and which will be reported; but, as far as appears at present, it is prevention by treatment beforehand that needs working out, for remedies are necessarily both enormously expensive and not always of service.

With regard to ox warble-fly, excellent communications are being sent in, and arrangements being made for further observations and reports on the few points still needed.

From specimens sent of the warble in hides recently removed from the animal, I have found that when the grub within has reached its full development, late in the spring, that a kind of skin has formed round all the upper part of the surface of the perforation through the hide, which appears quite to account for the perforation frequently (if not always) not healing perfectly after the grub has left it. The point of killing the maggot in the warble is easily managed, and, if this could be done at the first beginning of the formation of the warble, whilst the sore was still small and unhealed, instead of when after some months the grub cavity is large, and the upper part healed over all round the opening, a great amount of injury to cattle, and their hides, and loss to the owners would be saved.

The great point that we now want information on is when the first swelling and ulceration of the warble, and the opening of the small orifice (in which the black extremity of the grub is visible), takes place.

On the Continent this is stated to be in autumn ; here I have not as yet received information of the warble being noticed earlier in the winter than January. In this matter the skinners' or butchers' assistants, who have the opportunity of seeing the swelling of the warble plainly in the subcutaneous tissues of the hide, would be the best helpers. We might thus learn when it was first seen in various districts, and attention be thus directed in good time to the cattle of herds commonly infested.

A great deal of assistance is being given on these and other points from the district of Aspatria, Cumberland ; and I wish to acknowledge with thanks the assistance of Mr. Henry Thompson, the veterinary surgeon there, in sending specimens and procuring co-operation in observation throughout that neighbourhood. The result of the observations now in progress, as to egg-laying on the cattle, date of appearance of warble, and other details, will be submitted in the autumn report, with details also of the washes and applications to the backs of the cattle which have been found preventive of attack, and all other points which may be of practical use. I have prepared a series of illustrations of the warble-fly attack, and some connected points, which, if permitted, I shall be happy to place at the service of the Society.

Enquiries have been received respecting the great outbreak of the grass-moth caterpillars on the Ystradyfodwg mountains, and other localities, beginning at Bwlchyclawdd, near Rhondda, in South Wales. Specimens sent appear to belong to the antler moth, the *Chareas graminis*, which appears from time to time in vast hordes ; but it is very possible that there may be one or two other kinds of moth caterpillars nearly allied in

habits also present. Specimens have also been sent of the small green willow-beetle, the *Phratora vittilina*, which had been causing serious injury to willow grounds near Lymm, Cheshire, but was met by most careful and judicious co-operative measures on the part of the growers.

To all these and other applications sent in I have given the best attention in my power.

August, 1884.

Autumn Treatment for Prevention of Daddy Longlegs attack.—During this year, as well as on previous occasions, I have received many communications showing the great prevalence of daddy-longlegs' grubs in crops put in after broken-up pasture or clover ley.

The undisturbed state of the surface leafage in such situations just suits the flies for egg-laying, and (when merely turned down by the plough) the grub easily comes up again to the crop. Any measures which will disturb the surface or make it poisonous to the hatching grubs are certain to be of use.

Brush harrowing does some good by tearing up much of the surface rubbish in which the fly lays; penning and hand-feeding sheep makes the land obnoxious for egg-laying, and the trampling and sodden state of surface kills any stray grubs.

Early breaking up is very useful, as the fly looks for moist places, and this operation presents them instead with the dry and bare underside of the land-slice. But where special treatment is not convenient, much good may be done by applying in good time (that is as soon as, or before, the daddy flies appear) such regular agricultural dressings as will destroy the top herbage, and thus prevent it attracting the flies, and will likewise kill the hatching grub, and in due time, when mixed and worked by cultivation, be useful for manure.

Heavy dressings of lime fresh from the kiln, and spread hot; gas-lime at the rate of about 2 cwt. the acre, if caustic, or in larger proportion after some six months' exposure; salt at from 6 to 12 cwt.; and lime and salt mixed, may all be expected to be serviceable. Salt acts well at about 10 cwt. per acre by also destroying couch or twitch; and gas-lime is useful as rather increasing than lessening the value of the farmyard-manure applied, and likewise preventing small lumps spread about from becoming shelters for attack.

It is no harm to kill the surface vegetation at the autumn dressing, and the heavy application, when mixed in the land, will do nothing but good to the next crop.

Winter cultivation cannot be trusted to as a means of getting

rid of "grub," as it can be with caterpillars, for the "leather-jacket-grubs" will bear being frozen stiff without being injured, and also will bear being under water of ordinary temperature for at least a couple of days and nights without being drowned. But thoroughly good cultivation, to put the land in such good heart as will send the crop growth well on, is of great service in case attack does occur, and will often save the need of special applications to press it on afterwards.

The above treatment is equally serviceable for the prevention of wireworm, and dressings of lime, or gas-lime, have been reported as especially useful in preparing land to prevent attack of the turnip and cabbage-root maggot.

XXVI.—*Report of the Consulting Botanist.*

By W. Carruthers, F.R.S.

July, 1884.

The work of examining and testing seeds has considerably increased during the current year. Five hundred and forty-three samples have been, up to this time, submitted to me. In too many cases the seeds have been sent just before they are wanted to be sown, and the report of the germination has come too late to be of practical use. It is overlooked that the germination, while it is hastened by artificial appliances, is a matter of time, and that a report of the results would be untrustworthy if it were sent before the experiment had exhausted itself, would be unfair to the seedsman, and, moreover, of no value in a case of law.

The general result of the examination of the seeds this year is, that there is a decided improvement in the quality of the seeds. Take, for example, the seeds of the meadow fescue. In 1883, I found only 26 per cent. of the samples of this grass free from rye-grass. This year the percentage has risen to 70; and even the adulterated samples have less of the rye-grass introduced, for only 4 per cent. had over 50 per cent. of rye-grass this year, as compared with 16 per cent. last year. In the foxtail a still more gratifying result has to be reported. Last year no less than 40 per cent. of the samples failed to reach the low standard adopted for this grass by the Council; while this year I have not had before me a single sample that has not germinated more than 20 per cent., and nearly half of the samples have germinated more than 50 per cent. This fully justifies

the raising of the standard for this grass, and is a very important result of the Society's work.

The presence of ergot has been more abundant in the samples of fiorin examined this year than recently. I have detected it in samples of other grasses, but only very rarely; but some singularly good examples of fiorin were rendered worse than useless by the presence of this most dangerous parasite. No less than 60 per cent. of the fiorins were thus affected. In one case, where a quantity had been purchased by a member of the Society, who had specially contracted that it should be free from ergot, though it was found to be a remarkably good sample, it was very badly ergoted. Unfortunately he had used a portion of it in a mixture which he had sown on a five-acre pasture adjoining some good marsh-land before receiving my report, and had also mixed the remainder with other seeds, which were thus rendered useless. In reply to his complaint, the seedsman informed him that he had only a day or two before discovered the ergot in the seed, and then sought to minimise the injury by pointing out the smallness of the ergot. The ergot of fiorin, however, though very small, is as fully capable of developing the disease in the other grasses of the pasture as the more bulky and obvious ergots of the larger grasses.

The substitution of the worthless wavy mountain hair-grass (*Aira flexuosa*) for golden oat-grass continues to a very serious extent; no less than three-quarters of the specimens submitted to me as golden oat-grass consisted entirely of this worthless substitute.

The presence of dodder in clovers has been this year more abundant; in one-fifth of the samples of red clover, and one-fourth of those of alsike, the seeds of this parasite have been more or less abundant.

The most important step taken this year towards securing the best seeds has been the guaranteeing by various firms in the seed-trade the purity and germination, subject to the examination of an experienced botanist. The result has been most satisfactory, and has fully established that a guarantee can be safely given by the dealer who has determined for himself the quality of the seed he is selling. I have examined three series of samples that I have known to be guaranteed, and the guarantees of which have been communicated to me. From correspondence I know that guarantees have been given in other cases, but the nature of the guarantee has not been communicated to me. I have no information as to the merchant from whom the first and second series of samples were obtained, but from the correspondence in the guarantees for each sample of the three series I assume that they have been supplied by the same seedsman.

The third series of samples I examined twice, first the samples submitted by the merchant, and then samples drawn from the bulk supplied, the purchase of which was dependent on the analysis and trials being up to the standard specified in the guarantee. The following are the results of the four independent examinations.

	Guarantee.	First Trial.	Second Trial.	Third Trial.	Fourth Trial.
Meadow Fescue	90–95	95	94	98	96
Tall Fescue	80	87	91	90	87
Hard Fescue	85–90	..	85	83	92
Rough Meadow Grass	70	55	86	88	91
Timothy	95	100	99	95	99
Cocksfoot	90	92	94	92	88
Dogstail	90	98	95	97	95
Foxtail	70	67	67	80	75
Red Clover	90–95	..	99	90	98
Alsike	90–95	..	95	94	98
White Clover	90–95	..	94	100	94
Yarrow	75	90	81	86	83

The guarantees given above are those for the samples in the third and fourth trials. The only variations in regard to the samples for the other trials were as follows:—For the first trial samples the meadow-fescue was guaranteed 90 per cent., the dogstail 85 to 90 per cent., and no guarantee was given with the yarrow, at least no guarantee was communicated to me; for the second trial samples the meadow-fescue was guaranteed 95 per cent., the hard fescue 85 per cent., the yarrow was guaranteed "good germination," and the three clovers 95 per cent.

The only real divergence from the guarantee was in the case of the sample of meadow-grass in the first series; I am unable to account for this exception. Before giving the result of the year's work in my Annual Report, I will again test this sample, with the view of ascertaining the explanation. For the remainder of the samples it is obvious that the merchant or merchants, while guaranteeing a high germinating percentage, were supplying seeds of such ascertained quality that they were more than able to cover their high guarantee.